IN THE UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
AUSTIN DIVISION

AMERICAN STEWARDS OF LIBERTY, *et al*., Plaintiffs, JOHN YEARWOOD and WILLIAMSON COUNTY, TEXAS, Plaintiff-Intervenors, v. DEPARTMENT OF INTERIOR, *et al*., Defendants, CENTER FOR BIOLOGICAL DIVERSITY, DEFENDERS OF WILDLIFE, and TRAVIS AUDUBON, Defendant-Intervenors.	)	Civil No. 1:15-cv-01174-LY **DEFENDANT-INTERVENORS' EXCERPTS OF ADMINISTRATIVE RECORD**

BATES NUMBERS	NAME OF DOCUMENT
M003393 – M003424	90-Day Finding on a Petition to Remove the Bone Cave Harvestman From the List of Endangered and Threatened Wildlife
M003626 – M003632	Letter from George Veni, Executive Director, National Cave and Karst Research Institution, to Michael Warriner, Supervisor, USFWS
R000315 – R000337	Bone Cave Harvestman (*Texella reyesi*) 5-Year Review: Summary and Evaluation

Administrative Record Excerpt 1

M003393 - M003424

90-Day Finding on a Petition to Remove the Bone Cave Harvestman from the List of Endangered and Threatened Wildlife

Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition To Remove the Bone Cave Harvestman From the List of Endangered and Threatened Wildlife

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of 90-day petition finding.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce a 90-day finding on a petition to remove the Bone Cave harvestman (*Texella reyesi*) from the List of Endangered and Threatened Wildlife under the Endangered Species Act of 1973, as amended (Act). Based on our review, we find that the petition does not present substantial scientific or commercial information indicating that the petitioned action may be warranted. Therefore, we are not initiating a status review in response to this petition. However, we are in the process of conducting a species status assessment and 5-year status review and we invite the public, including the petitioners and other interested parties, to submit new data and information for consideration in this ongoing process. In particular, we ask the public to submit to us any new information that becomes available concerning the status of, or threats to, the Bone Cave harvestman or its habitat at any time.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(A) of the Act (16 U.S.C. 1531 et seq.) requires that we make a finding on whether a petition to add a species to ("list"), remove a species from ("delist"), or reclassify a species on the Lists of Endangered and Threatened Wildlife and Plants presents substantial scientific or commercial information indicating that the petitioned

action may be warranted. We are to base this finding on information provided in the petition, supporting information submitted with the petition, and information otherwise available in our files. To the maximum extent practicable, we are to make this finding within 90 days of our receipt of the petition and publish our notice of the finding promptly in the **Federal Register**.

The Services revised the regulations at 50 CFR 424.14 to clarify the procedures under which the Services evaluate petitions effective October 27, 2016 (81 FR 66462; September 27, 2016). We originally received the petition that is the subject of this document on June 2, 2014, with supplemental information received on October 5, 2016. We therefore evaluated this petition under the 50 CFR 424.14 requirements that were in effect prior to October 27, 2016, as those requirements applied when the petition and supplemental information were received.

Our standard for substantial scientific or commercial information with regard to a 90-day petition finding was "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted" (50 CFR 424.14(b)(1)). If we find that substantial scientific or commercial information was presented, we are required to promptly conduct a species status review, which we subsequently summarize in a 12-month finding.

Petition History

On June 2, 2014, we received a petition from John Yearwood, Kathryn Heidemann, Charles and Cheryl Shell, the Walter Sidney Shell Management Trust, the American Stewards of Liberty, and Steven W. Carothers requesting that we remove the endangered Bone Cave harvestman from the Federal List of Endangered and Threatened

Wildlife. The petition clearly identified itself as a petition and included the requisite identification information for the petitioners, as required at 50 CFR 424.14(a) (now 50 CFR 424.14(c)(1)). On June 1, 2015, the Service published a 90-day finding in the **Federal Register** (80 FR 30990) that the petition did not present substantial scientific or commercial information indicating that the petitioned action was warranted. On December 15, 2015, the American Stewards of Liberty, Charles and Cheryl Shell, Walter Sidney Shell Management Trust, Kathryn Heidemann, and Robert V. Harrison, Sr. challenged the 2015 90-day finding in Federal district court. The Service sought the court's permission to reconsider the 90-day finding. On December 22, 2016, the court ordered the Service to complete a new 90-day finding and deliver that finding to the **Federal Register** on or before March 31, 2017. This 90-day finding supersedes the Service's previous 2015 90-day finding, and is made pursuant to the court's December 22, 2016 order, the 2014 petition, and the additional reference materials accompanying the petition.

Previous Federal Actions

On September 16, 1988, the Service determined that the Bone Cave harvestman was endangered under the ESA (53 FR 36029). The 1988 final listing determination included five separate species, one of which was the Bee Creek Cave harvestman. Subsequent scientific studies concluded that the Bee Creek Cave harvestman actually consisted of two separate species: the Bee Creek Cave harvestman and the Bone Cave harvestman. As a result, the Service made a technical correction to include both species on the list of endangered species (58 FR 43818; August 18, 1993).On March 14, 1994, we published a 90-day finding (59 FR 11755) on a petition to delist the Bone Cave

harvestman in which we found that the petition did not present substantial scientific or commercial information indicating that the petitioned action may have been warranted. We developed a draft recovery plan on June 7, 1993, and made it final on August 25, 1994 (Service 1994b). On December 4, 2009, we completed a 5-year review of the Bone Cave harvestman, which recommended that the species remain listed as endangered (Service 2009). On June 1, 2015, we published a 90-day finding (80 FR 30990) on a petition to delist the Bone Cave harvestman which was subsequently withdrawn. This 90-day finding supersedes the Service's 2015 90-day finding. We announced our initiation of a 5-year review of the Bone Cave harvestman, and requested information for that review, on April 15, 2015 (80 FR 20241).

Species Information

For information on the biology and life history of the Bone Cave harvestman, see the final rule listing this species (53 FR 36029; September 16, 1988), the Endangered Karst Invertebrates Recovery Plan for Travis and Williamson Counties (Service 1994b), and the 5-year Status Review for the Bone Cave Harvestman (Service 2009), all posted at *http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=J009*. For information on preserve design and management for karst invertebrate species conservation, see the Karst Preserve Design Recommendations (Service 2012) and the Karst Preserve Management and Monitoring Recommendations (Service 2014) posted at *http://www.fws.gov/southwest/es/AustinTexas/ESA_Sp_KarstInverts.html*.

Evaluation of Information for This Finding

Under section 3(16) of the Act, we may consider for listing any species, including subspecies, of fish, or wildlife, or plants, and any distinct population segment of any

species of vertebrate fish or wildlife that interbreeds when mature (16 U.S.C. 1532(16)). Such entities are listed under the Act if we determine that they meet the definition of an endangered or threatened species.

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations at 50 CFR 424 set forth the procedures for adding a species to, or removing a species from, the lists of endangered and threatened species. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence.

We must consider these same five factors in delisting a species. We may delist a species according to 50 CFR 424.11(d) if the best available scientific and commercial data indicate that the species is neither endangered nor threatened for the following reasons: (1) The species is extinct; (2) The species is recovered; or (3) The original data for classification were in error. According to 50 CFR 424.11(d)(3), a species may be delisted when subsequent investigations "show that the best scientific and commercial data available when the species was listed, or the interpretation of such data, were in error."

In making this 90-day finding, we evaluated whether the petition presented substantial information indicating that the petitioned action (delisting) may be warranted. The petition did not assert that the Bone Cave harvestman is extinct, nor do we have

information in our files indicating that the species is extinct. The petition asserted that new information indicates that the original data, or our interpretation of the data, used in the listing of this species were in error. The petition also states that significant conservation has been put in place since the species was listed, such that the species is recovered.

In 2009, we conducted a 5-year status review of the Bone Cave harvestman (Service 2009). The purpose of a 5-year status review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on a 5-year review, we recommend whether a species should be removed from the List of Endangered and Threatened Wildlife, be changed in status from endangered to threatened, be changed in status from threatened to endangered, or remain at its current status. As part of the 2009 Bone Cave harvestman review, we evaluated whether the species had met the recovery criteria laid out in the species' recovery plan (Service 1994b, pp. 86–89).

Our Recovery Planning Guidance (NMFS and Service 2010) points out that recovery criteria should address the biodiversity principles of resiliency, redundancy, and representation (Schaffer and Stein 2000). Resiliency is the ability of a population or species to persist through severe hardships or stochastic events.

Redundancy refers to ensuring a sufficient number of populations to provide a margin of safety to reduce the risk of losing a species or certain representation (variation) within a species due to catastrophic events or other threats.

Representation involves conserving "some of everything" with regard to genetic and ecological diversity to allow for future adaptation and maintenance of evolutionary

potential. Representation and the adaptive capabilities (NMFS and Service 2010, p. 76994) of the Bone Cave harvestman are also important for long-term viability. Because a species' genetic makeup is shaped through natural selection by the environments it has experienced (Shaffer and Stein 2000, p. 308), populations should be protected in the array of different environments in which the invertebrate species occur as a strategy to ensure genetic representation, adaptive capability, and conservation of the species. Generally, the more representation, or diversity, the species has, the more it is capable of adapting to changes (natural or human-caused) in its environment.

The recovery plan for the Bone Cave harvestman (Service 1994b, pp. 86–88) identifies criteria for reclassification (from endangered to threatened), but does not include delisting criteria because we were unable to determine criteria for delisting the species at that time. Although meeting recovery criteria is not the standard for delisting, these reclassification recovery criteria are discussed here as a way of measuring our progress toward recovery and assessing the current status of the species. The recovery plan identifies two criteria for reclassifying the species from endangered to threatened: (1) Three karst fauna areas (if at least three exist) within each karst fauna region in its range are protected in perpetuity. If fewer than three karst fauna areas exist within a given karst fauna region, then all karst fauna areas within that region should be protected. (2) Criterion (1) has been maintained for at least 5 consecutive years with assurances that these areas will remain protected in perpetuity.

Karst fauna regions are geographic regions delineated based on geologic continuity, hydrology, and species distribution (Service 1994b, p. 76). There are six karst fauna regions in Travis and Williamson Counties, Texas, that are known to contain the

Bone Cave harvestman (Service 1994b, p. 33): North Williamson, Georgetown, McNeil/Round Rock, Cedar Park, Jollyville Plateau, and Central Austin. These regions are used as a way to facilitate conservation of representation and redundancy (as defined above) throughout the species' range.

Karst geologic areas were initially established for Travis and Williamson Counties, Texas, in 1992 (Veni & Associates 1992) and subsequently incorporated as karst fauna regions into the Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas (Service 1994b, pp. 28-34). Karst species zones, geographic areas used to denote the potential for listed karst invertebrate occurrence, were revised in 2007 for Travis and Williamson Counties, Texas (Veni and Martinez 2007). That revision incorporated additional species occurrence data and more robust geological mapping, and provided a more refined assessment of species distribution. While some studies suggest specific karst fauna regions could be redefined (Paquin and Hedin 2004, p. 3250; White 2006, pp. 93-99), they remain an overall suitable conservation strategy to aid in species recovery (Veni and Martinez 2007, p. 25; Ledford *et al.* 2012, p. 12).

For the purposes of the recovery plan, a karst fauna area "is an area known to support one or more locations of a listed species and is distinct in that it acts as a system that is separated from other karst fauna areas by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna" that live their entire lives underground (Service 1994b, p. 76). Karst fauna areas should be far enough apart so that if a catastrophic event (for example, contamination of the water supply, flooding, disease) were to destroy one of the areas, that event would not

likely destroy any other area occupied by that species (Service 1994b, p. 76).

To be considered "protected," a karst fauna area must be sufficiently large to maintain the integrity of the karst ecosystem on which the species depends (Service 1994b, p. 87). In addition, these areas must also provide protection from threats such as red imported fire ants, habitat destruction, and contaminants.

The overall recovery strategy for the Bone Cave harvestman includes the perpetual protection and management of an adequate quantity and quality of habitat (three karst fauna areas in each karst fauna regions) that spans the species' geographic range and provides a high probability of the species' recovery and survival over the long term. Adequate quality (as discussed below) and quantity of habitat refers to both size and number of preserved karst fauna areas that are sufficient for supporting the karst invertebrates and the ecosystems upon which they depend (Service 2011, p. 16). The recovery plan criteria call for three karst fauna areas (preserves) in each karst fauna region. The size of karst fauna area preserves should be large enough to ensure resiliency, as discussed above, and to protect the environmental integrity of the karst ecosystems upon which the species depends. The number of karst fauna area preserves called for in the recovery criteria provides redundancy for the species. A minimal level of redundancy within areas representing differing ecological and genetic makeup is essential to provide a margin of safety for the species to reduce the risk of losing the species or representation (variation) within the species from catastrophic events or other threats (Shaffer and Stein 2000 pp. 307, 309–310; Groves *et al.* 2002, p. 506). The Bone Cave harvestman has significant geographic variability across its range, and loss of a significant number of locations in part of its range could result in loss of genetic and

ecological diversity. The conservation of multiple karst fauna area preserves across the Bone Cave harvestman's range should provide representation of the breadth of its genetic and ecological diversity to conserve its adaptive capabilities (Schaffer and Stein 2000, p. 308).

Adequate quality of habitat refers to (1) the condition and configuration of preserved lands with respect to the known localities for the species, and (2) the ability of the species' needs to be met to sustain viable populations. Due to the uncertainty in determining population viability of the Bone Cave harvestman, the design of preserves for its protection should be based on estimates and assumptions that favor a high probability for recovery of this species and the ecosystems upon which it depends as discussed below.

The Endangered Karst Invertebrates Recovery Plan for Travis and Williamson Counties (Service 1994b) calls for protecting karst fauna areas sufficiently large to maintain the integrity of the karst ecosystem on which the species depends. This focus on the ecosystem is consistent with the purposes of the Act, which include "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" (16 U.S.C. 1531(b)). Therefore, we recommend designing karst fauna area preserves to protect occupied karst feature(s) and associated mesocaverns (humanly impassable voids). For further guidance on how to provide for adequate quantity and quality of habitat at specific invertebrate locations, we have developed and refer to our Karst Preserve Design Recommendations (Service 2012).

According to our preserve design guidelines (Service 2012, p. 3-5), karst fauna area preserves should include the following: (1) Surface and subsurface drainage basins

of at least one occupied cave or karst feature; (2) a minimum of 16 to 40 hectares (ha) (40 to 100 acres (ac)) of contiguous, unfragmented, undisturbed land to maintain native plant and animal communities around the feature and protect the subsurface karst community; (3) 105-meter (m) (345-feet (ft)) radius of undisturbed area from each cave footprint for cave cricket foraging (cave crickets are an important source of nutrient input to the karst ecosystem) and to minimize deleterious edge effects; and (4) preserves free of pipelines, storage tanks, or other facilities (for example, water retention ponds) that could cause contamination.

Because of the difficulties determining the population viability and habitat requirements for Bone Cave harvestman, this method follows a precautionary approach, which provides guidance to avert irreversible risk when facing uncertainty (Service 2012, p. A-1). Life-history characteristics of this species indicate that it requires stable temperature and humidity (Barr 1968, p. 47; Mitchell 1971, p. 250), and suggest that this species cannot be reintroduced because it cannot withstand surface climatic conditions.

According to anecdotal reports provided to our Austin Ecological Services Field Office, limited efforts to maintain karst invertebrates in a lab setting have been unsuccessful. Additionally, captive propagation techniques have not been developed for karst invertebrates and may be challenging to develop because of their specific adaptations to subterranean environment. Further, the sample size that would likely be needed to reintroduce a population into a new location cannot be obtained from existing populations due to the cryptic nature of this species and the fact that often only a few individuals are observed per cave survey. Therefore, an attempt to re-establish a population after it has been extirpated is not feasible at this time. In addition, if a

preserve is later found to be insufficient to support the species due to surrounding developments being either too close or too dense, the potential for adequately conserving the site is lost.

Because the Bone Cave harvestman has a relatively long life span and low requirements for food, a decline in population size or even the complete extirpation of the population due to the influence of development or other threats may take years or even decades. Observations of this species over several years on a preserve that is too small for perpetual species preservation may not allow detection of declines that are actually occurring. If these observations are used as evidence that a preserve size was adequate, then the potential for long-term preservation of the species may be lost due to irreversible development surrounding the preserve. Therefore, preserve sizes should be established with caution and be large enough to account for the uncertainty in area requirements for a population.

According to the petition, there are now more known occupied locations identified; there were 6 confirmed caves at listing; 60 confirmed caves at the time the recovery plan was drafted; and 168 confirmed caves in 2009, when the 5-year status review was completed (53 FR 36029, September 16, 1988; Service 1994b, 2009). The petition also states that more locations are likely to be found. We acknowledge that there are more known locations since the time those documents were completed and that the increase is likely an increase in our knowledge, not a true increase in the number of populations or range; however, species are listed under the Act based on an overall assessment of their viability and threats to their continued existence and not a simple assessment of the number of sites or size of the species' range. Some of the ongoing

threats to the species include habitat loss to development, alteration of drainage patterns, alteration of surface plant and animal communities, and contamination.

The petition states that 94 karst preserve areas are currently providing significant conservation. While these karst preserve areas are an important tool for preserving the current population of Bone Cave harvestman, many of the existing protected areas referenced in the petition are too small to meet the Service's preserve design recommendations. As part of the 2009 5-year status review of the Bone Cave harvestman, we reviewed the status of all of the known locations of the harvestman (including 83 of the 94 mentioned in the petition) to assess whether the criteria from the recovery plan to reclassify the species from endangered to threatened had been met for the Bone Cave harvestman. We considered the habitat size and condition to evaluate whether the locations could meet the preserve design recommendations (a reflection of the potential to support a resilient population) and then also looked at whether legally binding mechanisms were in place to provide protection of these sites over the long term (in perpetuity).

Of the locations known at the time of the 5-year review, 21 areas appeared to have the potential to meet the preserve design criteria. Our status review refers to 21 areas, while the petition incorrectly indicates that the status review considered 28 sites. This discrepancy is because the petition considers each individual cave location, while our status review considered closely located caves to be part of the same karst fauna area. Of these 21 areas, 1 is no longer confirmed to have the species (Barker Ranch Cave No. 1), and 5 are now protected karst fauna areas (Priscilla's Well, Twin Springs, Cobbs Cavern, Karankawa, and Tooth Cave).

In addition, at most of the remaining locations (of the 21 areas), we lack information to confirm that they meet the preserve design criteria (such as whether the surface and subsurface drainage basins are protected; tract acreage; exact locations of the cave within the area; and management activities to protect against threats, such as red imported fire ants). Also, many of these areas do not have a legally binding mechanism that ensures perpetual protection and management. Hence, we are unsure whether those areas have adequate undeveloped acreage, management, or protection mechanisms to ensure the long-term protection and survival of the Bone Cave harvestman.

Of the five protected karst fauna areas that meet preserve design criteria, four occur in the North Williamson County Karst Fauna Region and one occurs in the Jollyville Plateau Karst Fauna Region. However, this species occurs in six karst fauna regions, and four of these have no protected karst fauna areas that are confirmed to meet preserve design recommendations. Therefore, the best available information indicates that the criteria for reclassification from endangered to threatened for this species have not been met, nor has adequate redundancy and representation (three karst fauna areas in each karst fauna region) been protected throughout the species' range, leaving the species vulnerable to existing threats including habitat destruction.

The petition asserts that four additional locations are known since the time of the 5-year review. However, the petition does not provide adequate information that would support whether these four additional locations are in a condition to meet preserve design recommendations. Based on information in our files, we are aware of one additional cave since the 5-year review that may meet preserve design recommendations in the North Williamson Karst Fauna Region; however, it is privately owned, and we are unsure about

the property acreage and if the site receives any type of protection or management. Regardless, the amount of protected karst fauna area still falls short of the criteria for reclassification from endangered to threatened.

Further, we reviewed 83 of the 94 caves identified in the petition as receiving some level of protection in the 5-year review. Two of the caves that we did not review (Cobbs Cavern and Whitney West Cave) are now in confirmed karst fauna areas mentioned above (Cobbs Cavern and Twin Springs); one (Pond Party Pit) is in the Beard Ranch Cave area discussed in the 5-year review; and we have no locality information or taxonomic verifications for the remaining caves, and this information was not provided in the petition.

The petition also asserts that threats to the species are not as severe as originally thought. We evaluate that information, below, with respect to the five listing factors.

Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range. In the 1988 listing rule (53 FR 36029), we stated that the primary threat to the Bone Cave harvestman was the potential loss of habitat due to development activities, which could result in filling in or collapsing of caves; alteration of drainage patterns; increase in flow of sediment, pesticides, fertilizers, and urban run-off into caves; and increase in human visitation and vandalism.

We also considered additional information on threats to the species when we developed the recovery plan for the species (Service 1994b, pp. 59–65) and when we conducted the 5-year status review of the species (Service 2009, p. 2), in which we concluded that no change in the species' status (that is, reclassification to threatened or delisting) was warranted. We also reviewed available threat information in our files and

in a 1993 petition when we made our negative 90-day finding on that petition to delist (59 FR 11755; March 14, 1994).

The current petition asserts that "[d]evelopment activities on the surface may not result in the significant loss or degradation of habitat for *T. reyesi* as originally thought" and suggests that evidence of this is persistence of the species in caves surrounded by developed areas. Examples given in the petition are Inner Space Caverns, Sun City caves, Weldon Cave, Three-Mile Cave, and Four-Mile Cave. However, the observation of the species in these locations does not mean their populations at these locations are thriving or can withstand the long-term impacts from development activities that are expected to occur to karst invertebrate populations in developed areas, as discussed in the listing rule, recovery plan, and 5-year status review for the Bone Cave harvestman. In addition, increased development provides greater opportunities for contamination events such as pipeline leaks or hazardous material spills.

Bone Cave harvestman populations may be declining or threatened even though they are still observed at a specific site. The petition does not provide adequate information to detect population trends for this species and it is not available from other sources. This species has life-history strategies that include characteristics such as low metabolic and reproductive rates, long life spans, and inherently low sample sizes, which make it difficult to detect population response to possible impacts (Poulson and White 1969, p. 977; Howarth 1983, p. 374). We indicated in the 1994 90-day petition finding (59 FR 11755) that more time was needed to detect if the species was declining; however, while more time has passed, we are still lacking adequate data to conduct a trend analysis. It may be infeasible to assess karst invertebrate population trends in any

statistically significant manner given their association with humanly inaccessible cave habitat such as mesocaverns (Krejca and Weckerly 2007, p. 287). Human surveyors likely only have the opportunity to survey individuals from a subset of the available habitat (Knapp and Fong 1999, p. 6).

The petition states that several Sun City caves are examples of areas where the species can persist in developed areas. However, the petition failed to provide data adequate to assess trends in the karst invertebrate populations since the development occurred. In addition, we worked with the Sun City developers when they designed the project to develop strategies that we believed at the time would avoid or minimize the possibility of "take" of listed karst species. While we now believe that most of the Sun City cave preserves are too small to meet our preserve design recommendations for recovery and long-term survival (Service 2012), we expect that the strategies and conservation measures put in place likely have reduced the rate of impacts to the species.

The commercial cave known as Inner Space Caverns is another example the petition provided where the Bone Cave harvestman continues to persist in a developed area. Although the Bone Cave harvestman may be present at Inner Space Caverns, this does not ensure its populations are robust and secure; they may still be declining, and are at risk due to competition with surface-dwelling invertebrates and other threats associated with development, such as the potential for contamination. This cave has an overgrowth of blue-green algae growing near cave lights where the petition states that this species has been observed. This type of algae is known as "lampenflora" and favors surface-dwelling invertebrate species that can out-compete karst invertebrate species (Mulec and Kosi 2009, p. 109; Culver 1986, p. 438), such as the Bone Cave harvestman. The petition

failed to provide any data adequate to assess trends in the karst invertebrate population in relation to the time (duration and frequency) that they have been exposed to the artificial lighting. Additionally, part of the cave footprint occurs under a major interstate highway and train tracks, both of which present a threat of a contaminant spill that could impact the species in the future.

Weldon Cave was another example in the petition of a cave occupied by the Bone Cave harvestman within a developed area. Based on the best available information in our files, this cave is surrounded by undeveloped open space. Other than a small portion of the subsurface drainage basin potentially being impacted by a school campus, this cave appears to meet our preserve design recommendations but is not within a developed area, as asserted in the petition. Three-Mile Cave and Four-Mile Cave were also provided in the petition as examples of developed caves wherein the Bone Cave harvestman is known to occur. According to the petition, surveys conducted by SWCA in 2008 and 2009 documented the Bone Cave harvestman at these locations. However, detailed survey data were not provided by the petitioners and were not in the SWCA 2009 "Annual Report of Activities Involving Endangered Karst Invertebrates under Threatened and Endangered Species Permit TE800611–2."

The petition also states that, since the Bone Cave harvestman uses mesocaverns, it is protected from surface development activities because mesocaverns are "geologically protected." We are unclear why the petition contends that mesocaverns are protected because mesocaverns are subject to rapid permeation of surface water (Cowan *et al.* 2007, p. 160), and karst landscapes (including mesocaverns) are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits

providing little or no filtration (White 1988, p. 149).

One of the major threats to the Bone Cave harvestman is habitat loss due to increasing urbanization. The Bone Cave harvestman is a troglobite, meaning it lives its entire life underground. Karst ecosystems are heavily reliant on surface plant and animal communities for nutrient input.

Caves in central Texas that are occupied by federally listed karst invertebrates, such as the Bone Cave harvestman, receive energy (or nutrients) primarily from (1) detritus (decomposing organic matter) that falls or is washed into the caves, and (2) energy brought into the caves by cave crickets (*Ceuthophilus* spp.) (Barr 1968, p. 48; Reddell 1993, p. 2; Lavoie *et al.* 2007, p. 114; Taylor *et al.* 2003, p. 3; 2004, p. 2; 2005, p. 97), which are found in most Texas caves (Reddell 1966, p. 33). Cave crickets forage widely in the surface habitat surrounding the cave. Karst invertebrates feed on the cave cricket eggs (Mitchell 1971, p. 251), feces (Barr 1968, pp. 51–53, Poulson *et al.* 1995, p. 226), and directly on the crickets themselves (Elliott 1994, p. 15).

Development within urbanized areas can destroy or alter the surface plant and animal communities on which karst invertebrates depend. As development increases within the cave crickets' foraging area, there may be dramatic shifts in the available food supply within the cave (Taylor *et al.* 2007, p. 7). The leaf litter and other decomposing material that make up most of the detritus from the surface plant and animal community may also be reduced or altered, resulting in a reduction of nutrient and energy flow into the cave. A study by Taylor *et al.* (2007) compared caves in urbanized areas that were impacted by development to those in natural areas and found that, even though a small area within a largely urbanized ecosystem may support a cave community where karst

invertebrates are occasionally seen, these populations are significantly lower than those found in caves in more natural, less developed ecosystems, most likely as a result of reduced nutrient input. Another study at Lakeline Cave in Travis County, Texas, was conducted in association with the issuance of a habitat conservation plan and accompanying section 10(a)(1)(B) permit issued for Lakeline Mall. That study is based on data collected from 1992 through 2011, which documented a significant decline during that 20-year timeframe in another endangered karst invertebrate, the Tooth Cave ground beetle (*Rhadine persephone*), and cave crickets as development increased (ZARA 2012, pp. 8, 10, 12). Further, at Lakeline Mall Cave, no more than three Bone Cave harvestmen have been observed during any single survey (ZARA 2012, p. 11). Also, no Bone Cave harvestmen were seen during 6 years (1993, 1999, 2001, 2006, 2009, and 2010) and 12 surveys in Lakeline Mall Cave (ZARA 2012, p. 11).

Available information in our files supports our projection in the 1988 listing rule (53 FR 36029) that development and human population would continue to increase within the range of the species. The population of the City of Austin grew from 251,808 people in 1970, to 735,088 people in 2007 (City of Austin 2007). This represents a 192-percent increase over the 37-year period. Population projections from the Texas State Data Center (2012, pp. 496–497), estimate that Travis County will increase 94 percent in population from 1,024,266 in 2010, to 1,990,820 in 2050. The Texas State Data Center also estimates an increase in human population in Williamson County from 422,679 in 2010, to 2,015,294 in 2050 representing a 377-percent increase over a 40-year timeframe. All human population projections from the Texas State Data Center presented here are under a high-growth scenario, which assumes that migration rates from 2000 to 2010 will

continue through 2050 (Texas State Data Center and the Office of the State Demographer 2012, p. 9). Urbanization and human population growth and development were identified as a threat in the original 1988 listing rule and continue to represent a threat to the species.

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes. In the 1988 listing rule for the Bone Cave harvestman (53 FR 36029), we did not identify any threats under this factor. Likewise, the petition and our review of the information in our files did not identify any threats under this factor.

Factor C: Disease or predation. In the 1988 listing rule (53 FR 36029), we stated that increased human population increases the threat of predation by and competition with exotic (nonnative) and native surface-dwelling species, such as sow bugs, cockroaches, and red imported fire ants. The petition states that "[r]ecent studies suggest that fire ants may not present as significant or as lasting of a threat to the species as originally believed." The information cited regarding red imported fire ants is identified in the petition as an article by Porter and Savignano (1990), which we previously considered in our finding on the 1993 petition (59 FR 11755; March 14, 1994), and another study by Morrison (2002). The petition states that "a subsequent study by Morrison in 2002 revisited the Porter and Savignano (1990) study area 12 years later and replicated their study."

Morrison (2002, pp. 2341, 2343–2344) found that arthropod communities had rebounded to pre-RIFA [red imported fire ant]-invasion levels and that all measures of native ant and other arthropod species' diversity had returned to pre-invasion levels. Red imported fire ants were still the most abundant ant species, but not nearly as abundant as

during the initial red imported fire ants infestation. He concluded that the impacts to arthropod communities by red imported fire ants might be greatest during and shortly after the initial invasion, but long-term impacts are likely not as significant as once believed. However, we note that Morrison (2002, p. 2342) also states that "it is quite likely that red imported fire ants did contribute directly or indirectly to the disappearance or reduction in numbers of species" and that their study "should not be interpreted as an indication that detrimental effects of invasive ants will simply disappear with time." In addition, this is not "new information" as we have already reviewed these articles and considered the information they provided in the Bexar County Karst Invertebrates Recovery Plan (Service 2011, p. 12) and in our Karst Preserve Management and Monitoring Recommendations (Service 2014, p. 3), which is applicable here as all central Texas endangered karst invertebrates have similar life-history characteristics, and one of the Bexar County invertebrates (the Cokendolpher Cave harvestman) is in the same genus (*Texella*) as the Bone Cave harvestman. In addition, red imported fire ants have been found within and near many caves in central Texas and have been observed feeding on dead troglobites, cave crickets, and other species within caves (Elliott 1992, p. 13; 1994, p. 15; 2000, pp. 668, 768; Reddell 1993, p. 10; Taylor *et al.* 2003, p. 3).

Factor D: The inadequacy of existing regulatory mechanisms. The 1988 listing rule (53 FR 36029) states that "there are currently no laws that protect any of these species or that indirectly address protection of their habitat." While the petition did discuss some new ordinances that appear to have been put in place since the time of listing, we do not have enough information to indicate whether or not these State and local ordinances provide enough protection from all threats to the Bone Cave harvestman

in perpetuity.

The petition states that "the regulatory landscape includes a number of measures contributing to the conservation of the species outside of the protections afforded by the Endangered Species Act of 1973, as amended." For example, they say that protections offered though the City of Austin are adequate to protect the species in Austin, Texas. In the course of our work, we have reviewed these regulations and understand that most caves that are defined by the City of Austin's Environmental Criteria Manual as a cave are provided a 46- to 91-m (150- to 300-ft) set-back area (City of Austin 2014, p. 13-3). However, a 46-m (150-ft) or 91-m (300-ft) set-back is not adequate to meet our preserve design criteria, does not protect the cave cricket foraging area, and potentially does not include the surface and subsurface drainage basins. Further, the City of Austin's regulations are not applicable across the full range of the Bone Cave harvestman because the species occurs in Travis and Williamson Counties, including areas outside the Austin city limits.

The petition states that the City of Georgetown Water Quality Management Plan for the Georgetown salamander will offer protection to the Bone Cave harvestman. They state that this plan encourages the use of best management practices to protect water quality at Georgetown salamander locations. However, there are few Bone Cave harvestman locations that occur near Georgetown salamander locations, so any protection offered to the harvestman would be limited. Further, it is not clear from the petition whether this mechanism is voluntary, regulatory, or is currently in effect. In addition, the petition did not provide enough detail for us to evaluate all benefits this plan would provide to the Bone Cave harvestman, and it appears that participation in this plan is at

least in part voluntary.

The petition states that the Texas Commission on Environmental Quality (TCEQ) Edwards Rules provide protection to recharge features on the Edwards Plateau and that this provides protection from pollution to the Bone Cave harvestman. In a discussion of Factor D in the Bexar County Karst Invertebrates Recovery Plan (Service 2011, p. 13), we state that "the TCEQ water quality regulations do not provide much protection to the species' habitat (see 65 FR 81419–81433 for more information). For example, while some TCEQ practices provide protection from water quality impacts, others, such as sealing cave entrances for water quality reasons, can harm karst invertebrates." Sealing cave entrances can be harmful by blocking off water (leading to drying) and nutrient input to the karst invertebrate habitat. In addition, not all of the caves and mesocaverns that the Bone Cave harvestman occurs in are considered recharge features and, therefore, would not receive some of the water quality protection measures. Also, not all locations of the Bone Cave harvestman are under the jurisdiction of the Edwards Rules.

Factor E: Other natural or manmade factors affecting the continued existence of the species. In the 1988 listing rule (53 FR 36029), we stated that this species is extremely vulnerable to losses because of its severely limited range and because of its naturally limited ability to colonize new habitats. We also stated that the very small size of the species habitat units and the fragile nature of cave ecosystems make this species vulnerable to even isolated acts of vandalism. The petition states, "Inner Space Cavern demonstrates that the species can persist in caves with frequent human visitation and may be more tolerant of related habitat modification than originally believed." They also provide Three-Mile Cave and Four-Mile Cave as examples of caves that have

experienced human use yet the species persists in them. The petition contends that, since the Bone Cave harvestman exists in Inner Space Caverns, human visitation is not a threat. The petition also states that Three-mile and Four-mile Cave had graffiti from the 1890s, 1920s, and 1950s. However, no detailed information was provided to demonstrate if these caves experienced continued human use. The petition also indicates that Four-Mile Cave was inaccessible to humans prior to 2009, due to boulders blocking the entrance. In addition, the petition provided no trend analysis for these caves. As stated earlier, the observation of the species in these locations does not mean the populations at these locations have not been impacted (in a way that is short of extirpation) or can withstand the long-term impacts that are expected to occur to karst invertebrate populations in developed areas or from human visitation.

In the species 5-year status review (Service 2009, p. 18), we said, "[a]lthough climate change was not identified as a threat to *T. reyesi* in the original listing document or in the recovery plan, the species' dependence on stable temperatures and humidity levels opens the possibility of climatic change impacting this species. Therefore, while it appears reasonable to assume that *T. reyesi* may be affected, we lack sufficient certainty to know how climate change will affect this species."

The petition states that "the use of small voids or 'mesocaverns' within the geologic formations known to support occupied caves mitigates the potential threat of climate change." We acknowledge that mesocaverns may provide some protection from fluctuations in temperature and humidity that may be induced by climate change. However, the presence of mesocaverns alone will likely not be sufficient to ameliorate all of the effects that climate change may pose to this species, especially in the long run.

Karst invertebrates depend on stable temperatures and high humidity (Barr 1968, p. 47; Mitchell 1971, p. 250). The temperatures in caves are typically the average annual temperature of the surface habitat and vary much less than the surface environment (Howarth 1983, p. 372; Dunlap 1995, p. 76). If average surface temperatures increase, this could result in increased in-cave temperatures, which could affect the Bone Cave harvestman.

Increased and/or more severe storms, as well as prolonged periods of high temperatures and drought between rainfall events, associated with anticipated climate change effects may also impact the cave environment. Changes in rainfall regimes may affect the harvestman in several ways, including directly either through flooding or indirectly by modifying their habitat or nutrient availability. Changes in rainfall regimes could (1) alter the moisture levels within the caves leaving them drier between floods, which could lead to desiccation of the Bone Cave harvestman; and (2) affect the amount and timing of nutrients washed into a cave, potentially resulting in longer periods between nutrient input. These changes to drier and less suitable conditions in the caves will likely cause the Bone Cave harvestman to retreat farther into mesocaverns and away from nutrients that are thought to be located in larger cave passages (Howarth 1987, pp. 5–7), causing individuals to spend more energy trying to acquire nutrients in an already stressed environment. In addition, caves in arid regions have been shown to have smaller invertebrate populations and diversity due to less moisture and nutrient availability (George Veni, National Cave and Karst Research Institute, pers. comm. 2010). Since the Bone Cave harvestman is also sensitive to these habitat parameters, it is reasonable to predict that the effects of climate change on these habitat parameters could affect its

populations in a similar manner despite the presence of mesocaverns.

Further, stochastic (random) events from either environmental factors (for example, severe weather) or demographic factors (which come from the chance events of birth and death of individuals) exacerbate threats to the species because of its small population size (Melbourne and Hastings 2008, p. 100). The risk of extinction for any species is known to be highly inversely correlated with population size (Pimm *et al.* 1988, pp. 774–775; O'Grady *et al.* 2004, pp. 516, 518). In other words, the smaller the population the greater the overall risk of extinction. Therefore, threats to the Bone Cave harvestman are exacerbated by its small population size, which makes it more vulnerable to existing threats.

Finding

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service (Services) use the rulemaking process in our administration of the Act, in particular section 4 of the Act. Section 4(b)(3) of the Act establishes deadlines and standards for making findings on petitions to conduct rulemakings under section 4. As stated above, the Services revised the regulations at 50 CFR 424.14 to clarify the procedures under which the Services evaluate petitions effective October 27, 2016 (81 FR 66462; September 27, 2016). We originally received the petition that is the subject of this document on June 2, 2014, with supplemental information received on October 6, 2016. We therefore evaluated this petition under the 50 CFR 424.14 requirements that were in effect prior to October 27, 2016, as those requirements applied when the petition and supplemental information were received.

We have reviewed the petition, including all accompanying materials, and

evaluated readily available, related information in our files. The results of the 2009 5-year review and the assessment of threats in the five factor analysis presented in this 90-day finding do not indicate that the original classification was made in error. The petitioners have primarily based their contention that the species can thrive in developed areas on information that we have previously considered and rejected while working on previous documents (Service 2009, 2012). Petitioners present limited new information, such as the fact that four occupied caves have been discovered since the 5-year status review. In addition, petitioners assert that seven other caves are occupied. However, we lack, and the petition did not provide, locality information or taxonomic verifications related to these potential additional locations of the species. The other arguments presented in the petition lack a large enough sample size to produce population trend information for the Bone Cave harvestman. The petition provided no trend analysis to indicate that this species can withstand the threats associated with development or climate change over the long term. In addition, these threats, particularly those related to development, appear to be increasing in severity. Based on our review and evaluation, we find that the petition does not present substantial scientific or commercial information indicating that the delisting of the Bone Cave harvestman may be warranted due to recovery, extinction, or error in the original scientific data at the time the species was classified or in our interpretation of the data.

Although this finding ends our formal consideration of the petition, we are in the process of conducting a species status assessment and 5-year status review. Specifically, section 4(c)(2)(A) of the Act requires us to review each listed species' status at least once every 5 years. On April 15, 2015, we published a notice in the Federal Register initiating

this review (80 FR 20241). The purpose of a 5-year review is to determine whether listed species should be removed from the list or changed in status under the Act. In this case, we are developing a species status assessment as a tool to inform the 5-year status review. The 5-year review will consider whether the species status has changed since the time of its listing or its last status review and whether it should be reclassified as threatened or delisted. We invite the public, including the petitioners and other interested parties, to submit new data and information for consideration in this ongoing process.

Much progress has been made toward recovery in the North Williamson and Jollyville Plateau Karst Fauna Regions. We encourage interested parties to continue to gather data and implement conservation actions across the range of the Bone Cave harvestman that will further assist with the conservation of this species. If you wish to provide information regarding the Bone Cave harvestman, you may submit your information or materials to the Field Supervisor, Austin Ecological Services Field Office (see **ADDRESSES**) at any time.

References Cited

A complete list of references cited is available on the Internet at *http://www.regulations.gov* and upon request from the Austin Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this document are staff members of the Austin Ecological Services Field Office.

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: _____

_____

Director, U.S. Fish and Wildlife Service

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: MAR 20 2017

James W. Kurth

James W. Kurth

Acting *Director, U.S. Fish and Wildlife Service*

Administrative Record Excerpt 2

M003626 – M003632

Letter from George Veni, Executive Director, National Cave and Karst Research Institution, to Michael Warriner, Supervisor, USFWS

National Cave and Karst Research Institute

21 March 2017

Michael Warriner, Supervisor
U.S. Fish and Wildlife Service
Austin Ecological Services
10711 Burnet Rd., Suite 200
Austin, TX 78758
Via e-mail: michael_warriner@fws.gov

Re: Commercial value of endangered karst invertebrates

Dear Mr. Warriner,

This letter responds to the issue about the commercial value of endangered karst invertebrate species that are federally listed in Texas, with emphasis on the Bone Cave harvestman (*Texella reyesi*). I am writing in two capacities. First, I am the Executive Director of the National Cave and Karst Research Institute (NCKRI), which was created by the US Congress in 1998 and mandated to:

1) further the science of speleology;
2) centralize and standardize speleological information;
3) foster interdisciplinary cooperation in cave and karst research programs;
4) promote public education;
5) promote national and international cooperation in protecting the environment for the benefit of cave and karst landforms; and
6) promote and develop environmentally sound and sustainable resource management practices.

Second, I have conducted extensive research and provided management guidance to the US Fish and Wildlife Service (USFWS) for the past 29 years since the karst invertebrates were listed. Most of this work occurred prior to my employment by NCKRI when I ran my own company that specialized in cave and karst environmental consulting.

While the issue in question focuses on the Bone Cave harvestman, my reply will apply to the Bone Cave harvestman and all of the listed karst invertebrates in Texas.

In general, the Bone Cave harvestman and all endangered karst invertebrates are easily dismissed as having no commercial value. They are tiny, relatively few in observable number, produce no known vital ecological services to humanity, and are difficult to observe in their dark, underground environments. However, this view point is quite limited and misses several important commercial contributions that can be classified into the following four categories that I elaborate on below:

- Research
- Conferences and publications

- Environmental/water supply protection
- Public education/tourism

Research

Study of the all of the listed karst species invertebrate and other species in their ecosystems began decades before the species were listed. Some of those studies were the foundation for the listings. Since the listings, studies of the karst ecosystems, not just the Bone Cave harvestman and the other listed karst invertebrate species, have intensified tremendously. I emphasize the importance of the ecosystems because the listed species do not occur in isolation from other animals. Understanding the ecology, life cycles, and conservation needs of the Bone Cave harvestman and other listed karst invertebrates requires an equal understanding of the non-listed species which share their habitat. In my experience, this is best illustrated by my work for USFWS that delineated "Karst Fauna Regions" based on the distribution of the listed species and associated non-listed species that defined regions of similar habitat in the Bexar (Veni, 1994, 2002) and Travis and Williamson County areas (Veni and Associates, 1992; Veni and Martinez, 2007). These Karst Fauna Regions stand as the foundation on which critical habitat and many other conservation measures are based (e.g., USFWS 1994, 2012).

The listing of the species focused biological attention on the critical need to study the invertebrates and associated non-listed species. My funded biological consulting projects alone included taxonomic specialists in the various animal groups who lived in nine US states (California, Iowa, Missouri, New Hampshire, New York, North Carolina, Ohio, Texas, and Virginia) and two countries (Canada and USA), as an example of interstate and intrastate commerce. Most of my projects were funded by private corporations and individuals, as well as by public agencies. I am aware of dozens of other consulting studies on the listed and associated non-listed species, including the listed Bone Cave harvestmen, and would not be surprised if such studies totaled in the hundreds. Scientists have been funded by diverse interstate and intrastate sources of grants and contracts to study these species. I am aware of published research on the listed and associated non-listed fauna in their ecosystems that were collectively supported by grants and contracts provided by:

- Austin Community Foundation (Bendik et al., 2013)
- Cave Research Foundation (Krejca, 2009)
- City of Austin (Bendik et al., 2013)
- Engineer Research and Development Center (Taylor and Krejca, 2005)
- La Cantera Development Company (Paquin and Hedin, 2004; White et al., 2009)
- Marist College (Espinasa et al., 2016)
- National Speleological Society (Krejca, 2009)
- North American Native Fishes Association (Krejca, 2009)
- P.E.O. Presidential Endowed Scholar Award (Krejca, 2009)
- Phi Kappa Phi (Krejca, 2009)
- Phi Sigma Biological Honor Society (Bendik et al., 2013)
- Sigma Xi (Krejca, 2009)

- Texas Department of Transportation (Paquin and Dupérré, 2009)
- Texas Parks and Wildlife Department (Bendik et al., 2013)
- University of Arizona (Gomez et al., 2016)
- University of Texas at Arlington (Bendik et al., 2013)
- University of Texas at Austin (Krejca, 2009)
- University of Texas at Austin Environmental Studies Institute (Krejca, 2009)
- University of Texas at Austin Institute for Latin American Studies (Krejca, 2009)
- University of Texas at Austin Zoology Department (Krejca, 2009)
- US Army (Taylor and Krejca, 2005)
- US Fish and Wildlife Service (Bendik et al., 2013; Paquin and Hedin, 2004; White et al., 2009)
- US National Science Foundation (Bendik et al., 2013; Gomez et al., 2016)

One important aspect of the above research is that it adds to the repository of human knowledge. History contains many examples of how pure research of no apparent commercial value was later found to have direct, broad application for practical commercial purposes (e.g. the importance of insulin to relieving diabetes). The proverbial and perhaps actual cure to cancer and many other human needs may be discovered through this foundational research on the listed karst invertebrates.

Conferences and publications

I am not aware of any conferences dedicated to the listed karst invertebrates. The Austin Field Office of the USFWS holds occasional "Karst Conservation Initiative" workshops and seminars that are attended by land managers, scientists, consultants, and students throughout the region.

In contrast, I am aware of a least 18 papers on the listed invertebrates and associated species presented at the 15th International Congress of Speleology, which was held in Kerrville, Texas in 2009 (White, 2009). Most of these were offered at a special symposium: Protection and Management of Rare and Endangered Subterranean Fauna. Dozens of other papers have been presented at other conferences and published in professional journals. The most focused publications on the species in question are the Texas Speleological Monograph series published by the Texas Memorial Museum, with issue numbers 1, 3, 5, 6, and 7 being especially notable as *Studies on the Cave and Endogean Fauna of North America, I-V*.

Environmental/water supply protection

In 2000, the citizens of the City of San Antonio voted to increase their taxes to raise $45 million to acquire environmentally sensitive land. After those funds were expended, they voted again but to raise $90 million in 2005, and again in 2010 for another $90, and most recently approving $100 million in 2015 (City of San Antonio, 2017) by a majority of nearly 80%.

The environmentally sensitive areas of interest were primarily over the recharge zone of the Edwards Aquifer, where this sole source water supply is naturally replenished by

rainfall. Much of this area overlaps with habitat of several of the listed karst invertebrates. A similar program was enacted in the City of Austin, but I am focusing on San Antonio because I was highly involved with the project as a member of the Scientific Evaluation Team that created the model to identify the most preferred lands to acquire. A key element of that model included the areas where endangered species were known, raising their value in importance in protecting the single most of important economic resource of that region—the water supply for nearly 2 million people (Veni et al., 2001).

These popular actions were initiated by citizens who were frustrated by the State's perceived limitations on protecting the Edwards Aquifer from urbanization. Acquisition of the land by purchase and easement proved a solution to the limited power of regulations. Similarly, although indirectly, numerous properties that were preserved to protect populations of karst invertebrates, also protect the quality and quantity of water that recharges the Edwards Aquifer in the San Antonio and Austin areas. Like the human species, the karst invertebrates require an adequate volume of water and that it be clean of the chemicals that pollute urban runoff. The volume of water replenishing the aquifer through these preserves could be calculated, and its commercial value determined. In addition to clean water, the air-filtering capacity of the abundant trees in these protected areas could be calculated. Two direct interstate and intrastate commercial values to the clean Edwards Aquifer water include commercial bottling companies (e.g. Artesia Springs water and Lone Star Brewing) and food sales (e.g. Pace Foods).

Public education/tourism

Several of the properties acquired for environmental and water protection, including protection of the listed karst invertebrates, are now parks and other publically accessible open spaces that enhance the quality of life in those communities. I'm not aware of any studies that have quantified how many people moved to those cities or into adjacent neighborhoods to enjoy those benefits, but expect they could be determined.

Sun City in Williamson County, Texas, prides itself on its lack of property fences and abundant freely accessible green spaces, yet many of those green spaces were set aside to protect the listed karst invertebrates, including the Bone Cave harvestman. Many of the homeowners may not be aware of the invertebrates, but they were willing to pay a premium for their homes next to those karst preserves. I can't help but believe that out-of-town visitors to such homes may stay a little longer in the area, infusing more of their income into the local economies, because of the amenities resulting from these protected endangered species areas. The Sun City Corporation has requested the Texas Speleological Survey to produce a book on the caves of Sun City that it could distribute to its residents. The book is in production.

While the listed karst invertebrates are not generally observable by the public, there are some locations where they might be seen. Inner Space Cavern is home to the Bone

Cave harvestman and hosts tens of thousands of visitors each year. I do not recall ever hearing that the owners of the cave advertise that fact, but I expect that if they did that it may increase visitation.

In contrast, the Texas Cave Management Association advertises on its website (http://www.tcmacaves.org/robberbaron/index.php) and on-site kiosk the presence of two endangered invertebrates in Robber Baron Cave, *Texella cokendolpheri* which is similar to the Bone Cave harvestman, and the blind spider *Cicurina baronia*. Hundreds of people are led through the cave each year, most of whom make donations to the nonprofit association to learn about the cave, its history, and inhabitants.

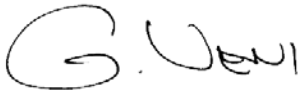
Further, at the National Cave and Karst Research Institute I have an exhibit plan for our museum that is in development. It includes a karst species viewing area. To the best of my knowledge, this will be the first exhibit where the general public can directly view and learn about karst invertebrate species, which will be concurrently studied by institute staff to learn more about the species' life cycles and to how to captive breed them in case of catastrophic loss in their native habitat. The listed karst invertebrates are not considered for display initially, but potentially at a later time when captive raising and display of related non-listed species proves that the listed species can be contained and raised safely. Generally over 400,000 people each year visit Carlsbad Caverns National Park, which is located near the institute, and I anticipate that many of those people will also visit the national cave and karst museum and science center we are creating.

Closing

I am not an economist and am not qualified to quantify the commercial economic value of the listed karst invertebrates. However, I believe I have shown that there is considerable and diverse direct, indirect, and potential commercial value to the species.

If you have questions or need additional information, please let me know.

Sincerely,



George Veni, Ph.D.
Executive Director

References

Bendik, Nathan F, Jesse M. Meik, Andrew G. Gluesenkamp, Corey E. Roelke, and Paul T. Chippindale. 2013. Biogeography, phylogeny, and morphological evolution of central Texas cave and spring salamanders. BMC Evolutionary Biology 2013, 13: 201, http://www.biomedcentral.com/1471-2148/13/201.

City of San Antonio. 2017. About the Edwards Aquifer. https://www.sanantonio.gov/EdwardsAquifer/About

Espinasa, Luis, Nicole D. Bartolo, Danielle M. Centone, Charisse S. Haruta, and James R. Reddell. 2016. Revision of genus *Texoreddellia* Wygodzinsky, 1973 (Hexapoda, Zygentoma, Nicoletiidae), a prominent element of the cave-adapted fauna of Texas. Zootaxa, 4126(2): 221–239, http://doi.org/10.11646/zootaxa.4126.2.3

Gómez, R. Antonio, James Reddell, Kipling Will, and Wendy Moore. 2016. Up high and down low: molecular systematics and insight into the diversification of the ground beetle genus *Rhadine* LeConte. Molecular Phylogenetics and Evolution 98: 161–175

Krejca, Jean K. 2009. New records for *Cirolanides texensis* Benedict, 1896 (Isopoda: Cirolanidae), including possible extirpations at impacted Texas caves. Cave and Karst Science, 35(1): 41-46.

Pierre Paquin & Nadine Dupérré. 2009. A first step towards the revision of *Cicurina*: redescription of type specimens of 60 troglobitic species of the subgenus *Cicurella* (Araneae: Dictynidae), and a first visual assessment of their distribution. *Zootaxa,* Magnolia Press, 67 pp.

Paquin, P. and M. Hedin. 2004. The power and perils of 'molecular taxonomy': a case study of eyeless and endangered *Cicurina* (Araneae: Dictynidae) from Texas caves. Molecular Ecology, 13: 3239-3255, doi: 10.1111/j.1365-294X.2004.02296.x.

Taylor, Steven J., and Jean K. Krejca. 2005. Foraging Range and Habitat Use of *Ceuthophilus secretus* (Orthoptera: Rhaphidophoridae), a Key Trogloxene in Central Texas Cave Communities. The American Midland Naturalist, 154: 97–114.

US Fish and Wildlife Service. 1994. Recovery plan for endangered karst invertebrates in Travis and Williamson counties, Texas. Albuquerque, New Mexico. 154 pp.

US Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; designation of critical habitat for nine Bexar County, TX, invertebrates. Federal Register, 70(30): 8450-8523.

Veni, George. 1994. Geologic controls on cave development and the distribution of endemic cave fauna in the San Antonio, Texas, region. Report prepared for Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service, George Veni and Associates, San Antonio, Texas. 99 pp.

Veni, George. 2002. Delineation of hydrogeologic areas and zones for the management and recovery of endangered karst invertebrate species in Bexar County, Texas. Report for the U.S. Fish and Wildlife Service, Austin, Texas, George Veni and Associates, San Antonio, Texas, 75 pp.

Veni, George, Joe Chapa, Geary Schindel, Kirk Nixon, and Dan Stone. 2001. GIS modeling of significant karst areas for purchase and protection. 15th National Cave and Karst Management Symposium, Tucson, Arizona, USDA-Forest Service, pp. 179-185.

Veni, George, and Cecilio Martinez. 2007. Revision of karst species zones of the Austin, Texas, area. Report of the Texas Parks and Wildlife Department, Austin, Texas, George Veni and Associates, San Antonio, Texas, 45 pp.

Veni and Associates, George. 1992. Geologic controls in cave development and the distribution of cave fauna in the Austin, Texas, region. Report for the U.S. Fish and Wildlife Service, Austin, Texas, 77 pp.

White, Kemble, Gregg R. Davidson, Pierre Paquin. 2009. Hydrologic evolution of the Edwards Aquifer recharge zone (Balcones fault zone) as recorded in the DNA of eyeless *Cicurina* cave spiders, south-central Texas. Geology, 37(4): 339-342.

White, William B., ed. 2009. Proceedings of the 15th International Congress of Speleology. National Speleological Society, Huntsville, Alabama, 3 vols.

Administrative Record Excerpt 3

R000315 – R000337

Bone Cave Harvestman (*Texella reyesi*) 5-Year Review:
Summary and Evaluation

Bone Cave Harvestman
(*Texella reyesi*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
Austin, Texas

5-YEAR REVIEW
Bone Cave Harvestman (*Texella reyesi*)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office: Southwest Regional Office, Region 2
Susan Jacobsen, Chief, Threatened and Endangered Species
505-248-6641
Wendy Brown, Recovery Coordinator, 505-248-6664
Julie McIntyre, Recovery Biologist, 505-248-6657

Lead Field Office: Austin Ecological Services Field Office (AESFO)
Cyndee Watson, Endangered Species Biologist
512-490-0057 x 223

1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act (16 U.S.C. 1531 et seq.). The Service provides notice of status reviews via the Federal Register and requests information on the status of the species. This review was conducted by Cyndee Watson and Bill Seawell from the AESFO. This status review mostly relied on information summarized and cited in Balcones Canyonlands Preserve (BCP)[1] Annual Report (BCCP 2009a)[2] and the BCP cave assessment (BCCP 2009b). We also used the draft Bexar County Karst Invertebrate Recovery Plan (Bexar RP) (Service 2008), which contains new karst invertebrate research and preserve design concepts; the Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas (Travis and Williamson RP) (Service 1994), and cave data contained within AESFO's files.

As a basic first step in assessing whether caves that contain *T. reyesi* met the downlisting recovery criteria in the Travis and Williamson RP, we compiled a list of some basic characteristics (further described in Section 2.2.3). While the Travis and Williamson RP discusses broad concepts regarding preserve design, the draft Bexar RP has an appendix that is a compilation of research to help more specifically delineate preserve boundaries that follow those basic concepts (Service 2008). These preserve design principles and characteristics describe what is needed to protect each karst feature and its surrounding

[1] BCP - A system of preserves permanently set aside to conserve habitat for 8 endangered species (including *T. reddelli*) and 27 species of concern as part of a joint regional 10(A)(1)(B) incidental take permit PRT 788841, held by the City of Austin and Travis County.
[2] BCCP - The incidental take permit mentioned above is also referred to as the Balcones Canyonlands Conservation Plan (BCCP).

area. From the list of known locations of these species, we identified those that had the highest likelihood of meeting these characteristics. Our determinations (discussed in section 2.2.3) for each of these characteristics were based on site-specific information found in the AESFO files and on cave location and parcel data. Unless otherwise noted, all acreage estimates were calculated using Geographic Information Systems (GIS) (2008 digital aerial photography, 2006 Travis County parcel data, and 2005 Williamson County parcel data) and are subject to typical margins of error associated with GPS units, GIS, and transferring data from paper sources to digital media. These acreages and respective cave locations need to be ground-truthed (i.e., verified by site visits).

1.3 Background:

The Bone Cave harvestman, *Texella reyesi*, is a troglobite which is a species restricted to the subterranean environment. As typical of troglobites, this harvestman exhibits morphological adaptations to that environment, such as elongated appendages and loss of eyes and pigment. Troglobitic habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Travis and Williamson Counties. Karst areas commonly have few surface streams; most water moves through cavities underground. Within this habitat this species depends on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter fallen or washed in, animal droppings, and animal carcasses. The harvestman is predaceous upon small or immature arthropods. It is imperative to consider that while these species spend their entire lives underground, their ecosystem is very dependent on the overlying surface habitat.

Texella reyesi was listed as endangered in 1988 based on the threats of: 1) habitat loss to development; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (i.e. the red-imported fire ant (RIFA), *Solenopsis invicta*), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; mining; quarrying (limestone); or, blasting above or in caves.

There are 168 caves known to contain *T. reyesi* in Travis and Williamson Counties, Texas (Table 1). Currently, *T. reyesi* faces the same threats that it did at the time it was listed.

1.3.1 FR Notice citation announcing initiation of this review:

75 FR 20134, April 23, 2007

1.3.2 Listing history

Original Listing
FR notice: 53 FR 36029
Date listed: September 16, 1988
Entity listed: Bone Cave harvestman (*Texella reyesi)*
Classification: Endangered

1.3.3 Associated rulemakings: In an August 18, 1993, Federal Register notice (56 FR 43818), the Service gave *T. reyesi* protection under the Act as a separate species. It had previously been listed as endangered as a part of the Bee Creek Cave harvestman (*Texella reddelli*), which was subsequently re-classified into two species, and this notice was made to ensure that it continued to receive protection under the Act.

1.3.4 Review History: Status reviews for *T. reyesi* were conducted in 1988 for the final listing of the species (53 FR 36029) and in 1994 for the Travis and Williamson RP (Service 1994).

1.3.5 Species' Recovery Priority Number at start of 5-year review: 2C

1.3.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for Endangered Karst Invertebrates (Travis and Williamson Counties, Texas)
Date issued: 1994

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? No, the species is an arachnid, so the DPS policy does not apply.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information: The recovery plan only provides criteria for downlisting from endangered to threatened (Service 1994).

Recovery Criteria: Each species will be considered for reclassification from endangered to threatened when:

(1) Three karst fauna areas (KFA) (if at least three exist) within each karst fauna region (KFR) in each species' range are protected in perpetuity. If fewer than three KFAs exist within a given KFR, then all KFAs within that region should be protected. If the entire range of a given species contains less than three KFAs, then they should all be protected for that species to be considered for downlisting.

(2) Criterion (1) has been maintained for at least five consecutive years with assurances that these areas will remain protected in perpetuity.

There are seven KFRs (adapted from the karst fauna areas in Figure 19 of Veni & Associates' 1992 report and reproduced in Figure 2 of the Travis and Williamson RP) in Travis and Williamson counties that are known to contain listed karst invertebrate species. These regions are delineated based on geologic continuity, hydrology, and the distribution of rare troglobites.

Within each KFR, established karst preserves may be considered a KFA if they meet recovery criteria. For the purposes of the recovery plan, a KFA is an area known to support one or more locations of a listed species and is distinct in that it acts as a system that is separated from other KFAs by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna. Karst fauna areas should be far enough apart so that if a catastrophic event (for example, contamination of the water supply, flooding, disease) were to destroy one of the areas, that event would not likely destroy any other area occupied by that species. To be considered "protected", a KFA must be sufficiently large to maintain the integrity of the karst ecosystem on which the species depend(s). In addition, these areas must also provide protection from threats such as red-imported fire ants (*Solenopsis invicta*) (RIFA), habitat destruction, and contaminants.

Brief summary of preserve design principles:
Much of the conservation and recovery of this endangered and cryptic species is dependent upon the long-term preservation of its habitat. Because most endangered karst invertebrates are difficult to detect during in-cave faunal surveys, their conservation strategies focus on the delineation, study, and management of occupied KFAs. Regarding size and configuration of KFAs, the Travis and Williamson RP provides some conceptual guidelines on habitat conditions that are important to karst invertebrates,

including maintaining humid conditions, air flow, and stable temperatures in the air-filled voids. Also necessary are maintaining adequate nutrient supply; preventing contamination from the surface and groundwater entering the karst ecosystem; controlling the invasion of exotic species, e.g., RIFA; and allowing for movement of the karst fauna and nutrients through voids between karst features (Service 1994).

Additional scientific information and karst preserve design guidelines are presented in the draft Bexar RP and help to further define a protected KFA (Service 2008). According to these preserve design guidelines, KFAs should include the following: 1) surface and subsurface drainage basins of at least one occupied karst feature (i.e., cave); 2) ideally a minimum of 24 to 36 hectares (ha) (59 to 89 acres (ac)) of contiguous, unfragmented, undisturbed land to maintain native plant and animal communities around the feature and protect the subsurface karst community; 3) 105 meter (m) (345 foot (ft)) radius, undisturbed area, from each cave entrance for cave cricket foraging; and 4) at least 100 m (328 ft), undisturbed, from the cave footprint to the edge of the preserve to minimize deleterious edge effects (Service 2008). The Bexar RP also recognizes various qualities of KFAs. A medium quality KFA is 16 to 24 ha (40 to 60 ac) and a high quality KFA is 24 to 36 ha (60 to 90 ac). Any karst preserve less than 16 ha (40 ac) will not count toward meeting the minimum Bexar County RP recovery criteria (Service 2008). The quality of KFAs is defined based on probability of long-term survival of the species in that area and the amount of active management necessary to maintain those species. High quality KFAs tend to be larger, require less active management, and have a higher probability of long-term species survival. Medium quality KFAs have some compromised characteristics of a high quality preserve, but still have potential for reasonable remediation. Additionally, the Bexar RP outlines perpetual management, maintenance, and monitoring necessary for ensuring a high probability of species survival at each site (Service 2008). At a minimum, these activities should include: 1) controlling RIFA; 2) installing and maintaining fencing; 3) installing, if necessary, and maintaining cave gates; and 4) monitoring of karst invertebrates and the ecosystem upon which they depend (Service 2008).

Analysis regarding whether downlisting criteria have been met:
There are currently 168 caves known to contain *T. reyesi*, spanning all 7 established KFRs in Travis and Williamson Counties, Texas (Table 1). These caves are within the North Williamson (55 caves), Georgetown (35 caves), McNeil/ Round Rock (61 caves), Cedar Park (2 caves), Jollyville Plateau (12 caves), Central Austin (2 caves), and the South Travis (1 cave) KFRs. Based on a review of available data, one karst preserve in the North Williamson County KFR currently meets the definition of a protected KFA, Priscilla's Well KFA. Other than this one KFA, there are 20 additional tracts in the North Williamson (6 tracts), Georgetown (3 tracts), McNeil/Round Rock (6 tracts), Jollyville Plateau (4 tracts), and South Travis (1 tract) KFRs that may meet the definition of a KFA. However, more research is needed to delineate surface and/or subsurface drainage basins, confirm locations and tract acreage, and confirm management activities at all caves that have potential to be a KFA. Below is a discussion of these tracts/caves and a description of how they have the potential to meet KFA status.

North Williamson County KFR

Priscilla's Well KFA – The Williamson County Conservation Foundation owns this 20 ha (51 ac) Priscilla's Well tract[3] that was recently acquired as a land donation as part of participation in the Williamson County Regional Habitat Conservation Plan (Williamson County RHCP) for the Ronald Reagan Boulevard extension. It has two caves (Priscilla's Cave and Priscilla's Well Cave) that contain *T. reyesi* and is considered a protected KFA by the Service. The cave entrances and footprints for both caves are more than 105 m (345 ft) from the nearest edge (i.e., disturbance e.g. road or a development) (SWCA 2008). The surface and subsurface drainage basins have been delineated based on topographic maps and are included in the preserve; however, onsite verification of the delineations has not been performed (SWCA 2008). As part of the management for these caves, the Williamson County Conservation Foundation will maintain fencing, conduct quarterly site visits looking for human intrusion and RIFA, and conduct annual cave fauna surveys.

Karankawa Cave and Polaris Cave

These privately-owned caves are located in a tract that is approximately 52 ha (130 ac) and have potential to meet the definition of a KFA because of the large amount of undeveloped land in and around this tract. The cave entrances for Karankawa Cave and Polaris Cave are located >700 m (>2,296 ft) and 609 m (2,000 ft) from the nearest edge, respectively. We do not have a map of the cave footprints so we cannot measure the distance to the nearest edge (i.e., disturbance via road or a development). To our knowledge the surface and subsurface drainage basins have not been delineated for either of these caves, so we do not know if they are inside this tract. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Shaman Cave and Pow Wow Cave – This >40-ha (>100-ac) tract is owned by Sun City and several other owners. Two caves on this tract contain *T. reyesi* and both have potential to meet the definition of a KFA. The cave entrance and footprint for Shaman Cave are located within the tract (Verdorn 1994) and the nearest edge (i.e., disturbance via road or a development) is >210 m (>700 ft) from the cave entrance; however, the cave footprint is <15 m (<50) ft away from the property boundary (although the adjacent tract is currently undeveloped so there is a possibility of protecting the area 100 m from the cave footprint). The surface drainage basin is likely included within the preserve (Verdorn 1994); however, the subsurface drainage basin has not been delineated to our knowledge. The nearest edge to the entrance of Pow Wow Cave is 143 m (470 ft) and the cave footprint is about 126 m (415 ft) (Verdorn 1994 and aerial photos). We do not have delineations of the surface or subsurface drainage basin for this cave, so we do not know if they are included in the tract. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Red Crevice Cave, Temples of Thor Cave, and Thor Cave

This 42 ha (105 ac) preserve is owned by Texas Cave Management Association (TCMA) and is known as the Godwin Ranch preserve. It was established as part of the mitigation

[3] Tract – refers to a contiguous undeveloped piece of land.

for Lakeline Mall (Simon 1992). Three caves on this tract contain *T. reyesi* and each has the potential to meet the definition of a KFA. The cave entrance and footprint for Red Crevice Cave are located within the tract (Simon 1992) and the nearest edge (i.e., disturbance e.g. road or a development) is about 200 m (about 656 ft) from the cave entrance. The distance from the nearest edge to the entrance of Temples of Thor Cave and Thor Cave is 121 m (400 ft) and 192 m (630 ft) respectively. We do not have maps of the cave footprints of Temples of Thor Cave or Thor Cave so we are unsure how far they are to the edge of the preserve. The surface and subsurface drainage basins have not been delineated for these caves to our knowledge; therefore, we do not know whether they are included in this tract. As part of the management for these caves, TCMA contracts with ZARA Environmental to conduct RIFA treatment; however, no cave fauna surveys are being conducted (ZARA 2008).

Jensen Cave

This cave is located on a privately-owned tract that is about 60 ha (150 ac) in area and is known to contain *T. reyesi*. Due to the size of undeveloped land within and around this tract, it has potential to be a KFA. The cave entrance is located 190 m (625 ft) to the nearest edge (i.e., disturbance e.g. road or a development). We do not have a map of the cave footprint and we do not have information on whether the surface and subsurface drainage basins for this cave have been delineated, so we do not know if they are in the preserve. Also, we do not know if these caves receive any management including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Lobo' s Lair Cave and Wolf' s Rattlesnake Cave

These caves are located on a privately-owned tract that is about 117 ha (290 ac) and are known to contain *T. reyesi*. Due to the size of undeveloped land within and around this parcel, it has potential to be a KFA. The cave entrance is located 701 m (2,300 ft) and 806 m (2,646 ft) to the nearest edge (i.e., disturbance e.g. road or a development) from Lobo' s Lair Cave and Wolf' s Rattlesnake Cave, respectively. We do not have a map of the cave footprint for either cave and we do not have information on whether the surface and subsurface drainage basins for these caves have been delineated, so we do not know if they are in the preserve. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Twin Springs

This recently-acquired preserve is on a 58 ha (145 ac) tract and contains 1 cave that is known to contain *T. reyesi* (Sunless City Cave) but it is too close to a road to be considered a KFA. However, a second cave (location needs to be verified) on the tract may contain *T. reyesi* pending taxonomic confirmation. Williamson County has indicated they plan to submit a detailed proposal as to how this area has the potential to be a KFA. Once we receive that information, we will consider whether this preserve has potential to be a KFA.

Georgetown KFR

Round Rock Breathing Cave

This privately-owned cave is located on a 21 ha (52 ac) tract and is known to contain *T. reyesi*. Due to the size of undeveloped land within this parcel, it has potential to be a KFA. The cave entrance is located 152 m (500 ft) from the nearest edge. We do not have a map of the cave footprint and we do not have information on whether the surface and subsurface drainage basins for this cave have been delineated, so we do not know if they are in the tract. Also, we do not know if this cave receives any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Steam Cave and Fence-line Sink

These two privately-owned caves are known to contain *T. reyesi* and are on a tract that is 60 ha (150 ac). Due to the size of undeveloped land within and around this tract, it has potential to be a KFA. The distance from the cave entrances are 396 m (>1,300 ft) and 274 m (900 ft) to the nearest edge (i.e., disturbance via road or a development) from Steam Cave and Fence-line Sink, respectively. We do not have maps of the cave footprints so we are unsure how far they are to the nearest edge. The surface and subsurface drainage basins have not been delineated for these caves to our knowledge; so we do not know whether they are included in this tract. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Wilco and Millenium Preserve

The Wilco Preserve is a 52 ha (130 ac) tract that is adjacent to the Millennium preserve which is a 36 ha (90 ac) tract. These two preserves were established with funding from the Williamson County Conservation Foundation, the Act' s Section 6 program, and Texas Department of Transportation (TxDOT) to offset impacts to *T. reyesi* from development and to provide recreational opportunities for the citizens of Williamson County. We do not have maps of the recreational facilities that are currently in place or future planned developments in relation to where the *T. reyesi* caves are on these preserves. However, Williamson County has indicated they plan to submit a detailed proposal as to how this area has the potential to be a KFA. Once we receive that information we will consider whether these two preserves have potential to be a KFA.

McNeil/Round Rock KFR

Blessed Virgin Cave

This privately-owned cave is located in a tract that is approximately 21 ha (52 ac) and has potential to meet the definition of a KFA because of the large amount of undeveloped land in and around this tract. The cave entrance is 359 m (1,180 ft) from the nearest habitat edge; however, it is <15 m (<50 ft) to the property line. We do not have a map of the cave footprints so we cannot measure the distance to the nearest edge. To our knowledge, the surface and subsurface drainage basins have not been delineated for this cave, so we do not know if they are inside this tract. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Weldon Cave

This privately-owned cave is part of the BCP (BCCP 2009b) and is known to contain *T. reyesi*. It occurs on a tract that is 32 ha (80 ac) and has potential to be a KFA due to the large amount of undeveloped land in this tract. The distance from the cave entrance to the nearest edge is 106 m (350 ft) (BCCP 2009b). The distance from the nearest habitat edge to the cave footprint is 96 m (347 ft) (based on Elliott 1997 and aerial photos). The surface drainage basin has been delineated but we are unsure whether it is included in the tract (BCCP 2009b). The subsurface drainage basin has not been delineated (BCCP 2009b). Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Rockfall Cave

This privately-owned cave is located in a tract that is approximately 9 ha (24 ac) and has potential to meet the definition of a KFA only because of the large amount of undeveloped land adjacent to this tract. The cave entrance is located 185 m (610 ft) away from the nearest habitat edge and about 3 m (10 ft) from the property line. We do not have a map of the cave footprint so we cannot measure the distance to the nearest edge. To our knowledge the surface and subsurface drainage basins have not been delineated for this cave, so we do not know if they are inside this tract. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Raccoon Lounge Cave

This privately-owned cave is located in a tract that is approximately 117 ha (290 ac) and has potential to meet the definition of a KFA due to the large amount of undeveloped land in this tract. There is a road going through this tract; however, it is about 243 m (800 ft) from the cave entrance, which is located 198 m (650 ft) away from the nearest edge (i.e., disturbance via road or a development). We do not have a map of the cave footprint, so we cannot measure the distance to the nearest edge to the cave footprint. To our knowledge the surface and subsurface drainage basins have not been delineated for this cave, so we do not know if they are inside this tract. Also, we do not know if this cave receives any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Wyoming Springs Corridor Caves

Two caves, WS 54 and WS 71a, occur on a privately owned tract that is 117 ha (290 ac). The adjacent privately-owned tract contains cave WS 65 and is 125 ha (310 ac). All three of these caves contain *T. reyesi* and have potential to meet the definition of a KFA due to the large amount of undeveloped land in these two tracts. While there is some disturbance (i.e., edge or disturbance by roads or development) in both of these tracts, the disturbance is located about 152 m (500 ft) from the closest cave entrance (WS 54a). The distance from the nearest edge to the cave entrance of caves WS 65 and WS 71a is 274 m (900 ft) and 198 m (650 ft) respectively. We do not have maps of the cave footprints, so we cannot measure the distance from the footprint to the nearest edge. To our knowledge the surface and subsurface drainage basins have not been delineated for these caves, so we do not know if they are inside this tract. Also, we do not know if these caves receive

any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Chaos Cave Preserve

This cave preserve was established to offset impacts to *T. reyesi* due to construction of State Highway 45 North (Consultation no. 2-15-1998-F-0205; TxDOT 2003). While this preserve is only 12 ha (30 ac) it is adjacent to large areas of undeveloped land, therefore it has potential to be a KFA. The 3 caves occurring on this tract, Chaos Cave, Under the Fence Cave, and Poison Ivy Cave, all contain *T. reyesi*; however, only the first 2 caves have the potential to be KFAs because Poison Ivy Cave is only 58 m (192 ft) from the nearest edge. The distance from the nearest edge (i.e., disturbance e.g. road or a development) to the cave entrance of Chaos Cave and Under the Fence Cave is 173 m (570 ft) and 137 m (450 ft), respectively (based on TxDOT 2003 and aerial photos). The distance from the cave footprint to Chaos Cave and Under the Fence Cave is 169 m (554 ft) and 136 m (446 ft) respectively (Veni 2003 and aerial photos). The surface drainage basin for Chaos Cave may be included in the preserve (Veni 2003); however, a detailed delineation has not been conducted. The surface drainage basin for Under the Fence Cave and the subsurface drainage basins have not been delineated for these two caves. Management for all three *T. reyesi* caves on this preserve includes biological surveys every three years, biannual cave cricket surveys, and biannual RIFA surveys (TxDOT 2003).

Jollyville Plateau KFR

Cuevas (Tomen Park)

This Travis County-owned tract contains several caves with listed species and three of these caves contain *T. reyesi* (Gallifer Cave, Tooth Cave, and McDonald Cave) and may meet the definition of a KFA. This cave cluster is within a tract that is 772 ha (1,909 ac) (BCCP 2009b). While Gallifer Cave, Tooth Cave, and McDonald Cave are the only three caves that have the potential to be considered a KFA for *T. reyesi*, all of the caves and karst features within this tract contribute to the long-term viability and stability of the KFA. The entrances and footprints for all of these caves are contained within this tract. The cave entrance for Gallifer Cave is 198 m (650 ft) and the cave footprint is about 189 m (620 ft) from the nearest edge (i.e., disturbance via road or a development) (Elliott 1997, Service 2008). The Tooth Cave entrance is 73 m (240 ft) from the nearest edge and the cave footprint is about 16 m (52 ft) from the nearest edge (Elliott 1997, Service 2008). The cave footprint distance for Tooth Cave was measured using the ground-penetrating radar map by Veni (2006). The cave entrance of McDonald Cave is 365 m (1,200 ft) to the nearest edge (BCCP 2009b) and the distance from the nearest edge to the cave footprint is about 335 m (1,099 ft) (based on Elliott 1997 and aerial photos). The surface and subsurface drainage basins for Gallifer Cave and Tooth Cave are included in this tract (Veni 2006). The surface drainage basin for McDonald Cave has been delineated and is included in the tract; however, the subsurface drainage basin has not been delineated (BCCP 2009b). As part of the management for these caves, the Travis County BCP staff conducts quarterly cave cricket exit counts, maintains the perimeter fences, and conducts biannual surface monitoring to look for signs of trespass and RIFA (BCCP 2009a). They also conduct an annual faunal survey at Gallifer Cave, quarterly

faunal surveys at Tooth Cave, and quarterly faunal surveys at McDonald Cave (BCCP 2009a).

Stovepipe Cave

The City of Austin owns this cave and it is part of the BCP (BCCP 2009a). It is known to contain *T. reyesi*. This 21 ha (52 ac) tract has a narrow connection to more than 1,695 ha (4,189 ac) of additional BCP land (BCCP 2009b) and the cave entrance and footprint are more than 105 m (345 ft) from any disturbance. The surface drainage basin is protected and included in the tract; however, the subsurface drainage basin has not been delineated (BCCP 2009a, b). As part of management for the cave, the City of Austin maintains the perimeter fence and conducts quarterly surface monitoring looking for human intrusion, implements RIFA control using boiling water, and conducts biannual cave fauna surveys (BCCP 2009a, b).

Four Points

This privately-owned and managed 21 ha (52 ac) tract has been preserved for the benefit of endangered karst invertebrates (Service 1994) and is considered part of the BCP[4]. Three caves in this tract contain *T. reyesi* (MWA Cave, Eluvial Cave, and Jollyville Plateau Cave), and have potential to meet the definition of a KFA. The distances from the nearest edge (e.g. road or development) are 128 m (420 ft), 152 m (500 ft), and 213 m (700 ft) from the entrance of MWA cave, Eluvial Cave, and Jollyville Plateau Cave, respectively (BCCP 2009b). The distances from the nearest edge to the cave footprint are 115 m (380 ft), 143 m (471 ft), and about 137 m (450 ft) to MWA Cave, Eluvial Cave, and Jollyville Plateau Cave, respectively (per aerial photography and Elliot 1997). This tract is adjacent to more than 162 ha (400 ac) of BCP land. The surface drainage basins have been delineated for all three of these caves but we are unsure if they are in the preserve (BCCP 2009b). The subsurface drainage basins have not been delineated (BCCP 2009b). As part of management for these caves, a perimeter fence was installed and RIFA are treated at least twice a year (ACI 2003, 2004, 2005, 2006, 2007).

Beard Ranch Cave

This City of Austin-owned cave is known to contain *T. reyesi* and is part of the BCP. It occurs on a tract that is 1,695 ha (4,189 ac) in area (BCCP 2009b). Due to the large amount of undeveloped land in this tract, it has the potential to be a KFA. The distance from the cave entrance to the nearest edge (i.e., disturbance due to road or a development) is 723 m (2,375 ft) (Dolph Scott, City of Austin, pers. comm., 2009). We do not have a map of the cave footprint, so we are unsure whether it is in the tract. The surface drainage basin is protected and included in the tract. The subsurface drainage basin has been delineated, but we are unsure whether it is in the tract (BCCP 2009b). As part of management for the cave, the City of Austin BCP staff conducts quarterly surface monitoring (BCCP 2009b).

[4] If preserves are established within the BCCP acquisition boundaries, they are considered part of the BCCP and contribute to the total acreage of the preserve system (Rose Farmer, Travis County, pers. comm. 2008).

South Travis County KFR

Barker Ranch Cave No. 1

This cave is located on the City of Austin's Water Quality Protection Lands on a tract that is 32 ha (81 ac) in area and contains *T. reyesi*. Due to the size of undeveloped land within and around this parcel, it has potential to be a KFA. The cave entrance is located 823 m (>2,800 ft) to the nearest edge (i.e., disturbance via road or a development). We do not have a map of the cave footprint and we do not have information on whether the surface and subsurface drainage basins for this cave have been delineated, so we do not know if they are in the tract. Also, we do not know if these caves receive any management, including looking for signs of trespass, RIFA, or monitoring of *T. reyesi*.

Table 1. Distribution of *T. reyesi*

Cave Name	Size of tract (ac)*	Notes
North Williamson KFR		
Priscilla's Well Cave	51	KFA
Karankawa Cave	130	potential KFA
Polaris Cave	130	potential KFA
Shaman Cave	100	10-ac setback in 100-ac undeveloped parcel; potential KFA
Pow Wow Cave	100	10-ac setback in 100-ac undeveloped parcel; potential KFA
Red Crevice Cave	105	Lakeline Mall mitigation; potential KFA
Temples of Thor Cave	105	Lakeline Mall mitigation; potential KFA
Thor Cave	105	Lakeline Mall mitigation; potential KFA
Jensen Cave	~150	potential KFA
Lobo's Lair	290	potential KFA
Wolf's Rattlesnake Cave	290	potential KFA
Flat Rock Cave	290	close to an edge
Twin Springs Cave	145	Williamson County Conservation Foundation
Sunless City Cave	145	close to a road
Snake Dancer Cave	130	1-ac setback
Prairie Flats Cave	3	3-ac setback
Abused Cave	15	
Williams Cave No. 1	15	
Cobb Drain Cave	?	close to road?
Coke Box Cave	?	close to road?
Duckworth Bat Cave	~10	
Cat Cave	~11	
Salt Lick Cave	6	
Salt Lick Cave	6	
3 Mile Cave	2	close to road?
Lizard's Lounge Cave	14	

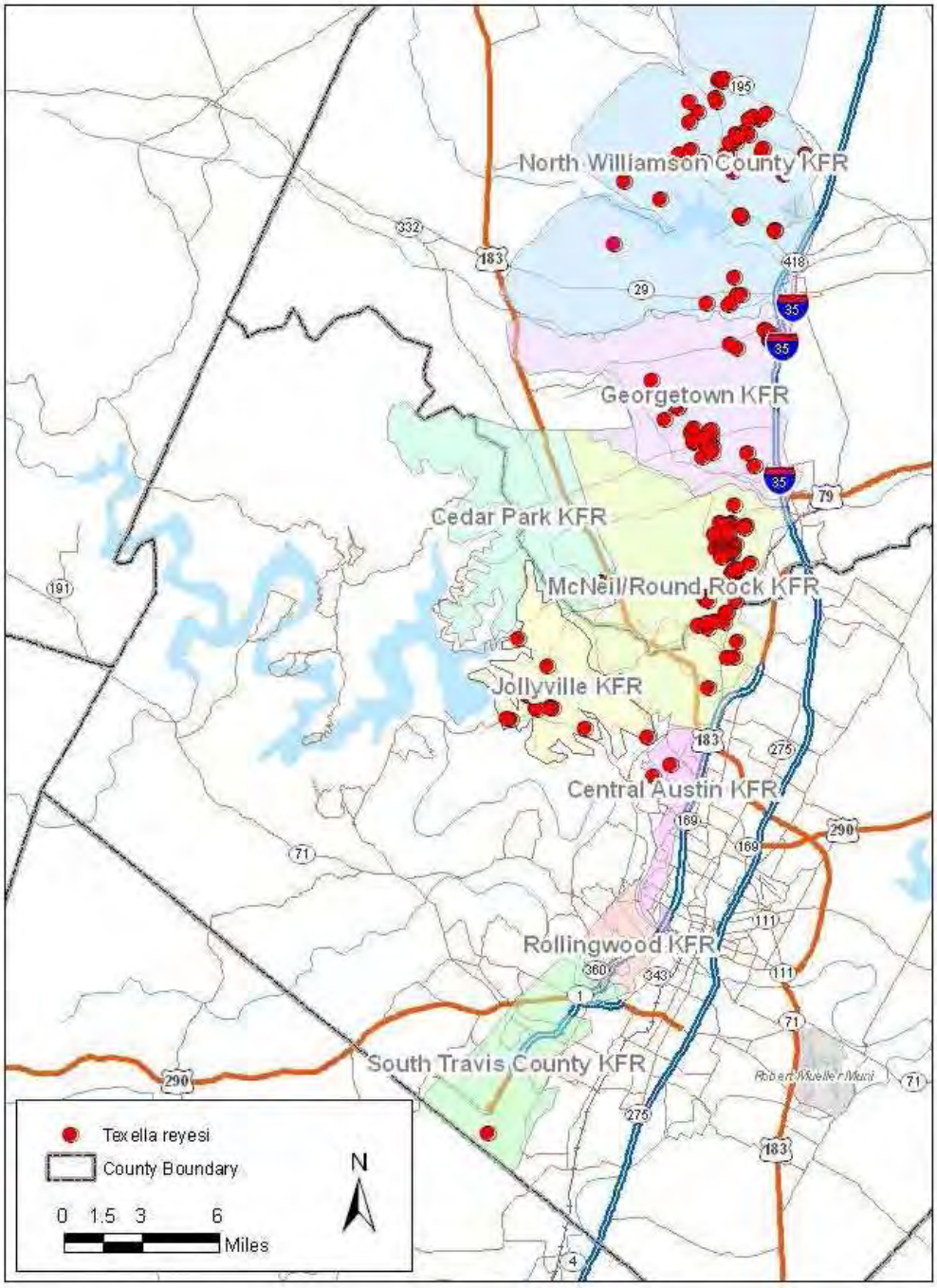
Dwarves Delight Cave	14	
Apache Cave	5	
Double Dog Hole Cave	5	
Choctaw Cave	4	3-ac setback
Ute Cave	37	15-ac setback
Venom Cave	37	15-ac setback
Unearthed Cave	37	
Deliverance No. 1 Cave	26	13-ac setback
Deliverance No. 2 Cave	26	13-ac setback
Trail of Tears Cave	26	14-ac setback
Do Drop In Cave	8	5- ac setback
Dragonfly Cave	13	8-ac setback
Electro-Mag Cave	15	8-ac setback
Kiva Cave No. 1	3	
Medicine Man Cave	12	8-ac setback
Turner Goat Cave	30	4-ac setback
You Dig It Cave	30	2-ac setback
Woodruff's Well Cave	10	1-ac setback
Yellow Hand Cave	2	1-ac setback
Holler Hole Cave	6	4-ac setback
Viper Cave	?	
Buzzard Feather Cave	~30	
Hourglass Cave	~30	
Cassidy Cave	<1	
Pussy Cat Cave	<2	
Rattlesnake Inn Cave	>1000	close to road
Texella Cave	<1	
Waterfall Canyon Cave	2	close to edge
Georgetown KFR		
Round Rock Breathing Cave	52	potential KFA
Fortune 500 Cave	52	close to edge
Ominous Entrance Cave	52	close to a road
Steam Cave	~150	potential KFA
Fence-line Sink	~150	potential KFA
Mongo Cave	130	Wilco Preserve
Wilco Cave	130	Wilco Preserve
Wild West Cave	130	Wilco Preserve
Rock Ridge Cave	130	Millennium Preserve
Through Trip Cave	90	Millennium Preserve
Little Demon Cave	90	Millennium Preserve
Millennium Cave	90	developed; ~100' from road
Yamas Cave	<14	

Mayfield Cave	?	
Bone Cave	?	
Brown^s Cave	<1	
Elm Cave	<1	developed; close to houses
Formation Forest Cave	linear	<10-ac setback
Posh Cave	<10	<20' from road
Step-Down Cave	<2	
Inner Space Cavern	4	150' from road
Man-With-A-Spear Cave	12	
Mayor Elliott Cave	~60	In 5-ac greenspace
Mosquito Cave	5	In 5-ac greenspace
Onion Branch Cave	5	
Off Campus Cave	<1	
On Campus Cave	40	close to edge
Price Is Right Cave	<1	
Rootin Tootin Cave	<5	
Short Stack Cave	linear	
Sierra Vista Cave	<1	
Snowmelt Cave	<1	
Tres Amigos Cave	<2	
Zapata Cave	linear	
Flowstone Rift Cave	7	
McNeil/Round Rock KFR		
Blessed Virgin Cave	52	potential KFA
Weldon Cave	80	potential KFA
Rockfall Cave	24	potential KFA because adjacent to undeveloped land with adequate acreage to be KFA
Raccoon Lounge Cave	290	potential KFA
WS-54	290	potential KFA
WS-71a	290	potential KFA
WS-65310	310	potential KFA
Chaos Cave	30	Chaos Cave preserve; potential KFA because adjacent to undeveloped land
Beck Tex-2 Cave	41	
Beck Horse Cave	41	
Beck Pride Cave	41	
Beck Bat Cave	41	
Flint Wash Cave	?	
Beck Crevice Cave	?	
Beck Blowing Well Cave	?	
Beck Sewer Cave	10	
Beck's Tin Can Cave	10	
Black Cat Cave	10	

Beer Bottle Cave	42	
Beck Ranch Cave	?	
Beck Rattlesnake Cave	?	
Broken Zipper Cave	?	54-acre greenbelt
Joint Effort Cave	?	26-acre greenbelt?
Beck Bridge Cave	26	
Cat Hollow Bat Cave	2	
Cat Hollow Cave #1	3	
Cat Hollow Cave #2	26	
O'Connor Cave	26	in greenbelt
Cave Coral Cave	28	
Poison Ivy Cave (not all CCF)	30	Chaos Cave preserve
Under-the-fence Cave	30	Chaos Cave preserve
El Tigre Cave	?	
Crescent Cave	?	
Ensor Cave	?	
Eulogy Cave	?	
Leachate Cave	?	
Jackhammer Cave	?	
Scoot Over Cave	?	
Serta Cave	?	
Underdeveloped Cave	?	
Undertaker Cave	?	
Vericose Cave	?	
Wild Card Cave	?	
Joker Cave	?	
Hollow Oak Cave	?	
Lineament Cave	?	
McNeil Bat Cave	20	
No Rent Cave	150?	cave may be mapped incorrectly
Fossil Garden Cave	?	
Millipede Cave	?	in school courtyard
Mustard Cave	?	mapped incorrectly
Pecan Gap Cave	230	close to road
Pencil Cactus Cave	230	close to road
Rocky Horror Cave	32	close to road realignment
Sam Bass Hideaway Cave	?	close to road
Stepstone Cave	?	
Swarm Cave	?	
Hole-In-The-Road Cave	?	
Cold Cave	8	

War Party Cave	32	near 2 subdivisions
Cedar Park KFR		
Lakeline Cave	<1	
Underline Cave	developed	
Jollyville Plateau KFR		
Gallifer Cave	1,909	BCP; potential KFA
Tooth Cave	1,909	BCP; potential KFA
McDonald Cave	1,909	BCP; potential KFA
Root Cave	1,909	BCP; not KFA by itself but other caves in tract are potential KFAs
Stovepipe Cave	55	potential KFA
MWA Cave	52	Four Points; potential KFA
Eluvial Cave	52	Four Points; potential KFA
Jollyville Plateau Cave	52	Four Points; potential KFA
Beard Ranch Cave	4,189	BCP owned; potential KFA
Geode Cave	145	close to road
New Comanche Trail Cave	254	Travis County owns and will monitor the entrance and conduct faunal surveys; close to road
Twisted Elm Cave	3	
Central Austin KFR		
Cotterell Cave	20	
West Rim Cave	?	
South Travis County		
Barker Ranch Cave No. 1	81	City of Austin-owned

*Unless otherwise noted all acreage estimates were calculated using Geographic Information Systems (GIS) (2008 digital aerial photography, 2006 Travis County parcel data, and 2005 Williamson County parcel data) and are subject to typical margins of error associated with GPS units, GIS, and transferring data from paper sources to digital media. These acreages and respective cave locations need to be ground-truthed (i.e., verified by site visits). Also caves that appear to have enough acreage to qualify as a KFA did not meet all other recovery criteria, e.g. distance to edge, surface, or subsurface drainage basins were not included in the tract.



Map 1. *T. reyesi* Distribution

Climate Change
According to the Intergovernmental Panel on Climate Change (IPCC) (2007) "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years (IPCC 2007). It is very likely that over the past 50 years: cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). It is likely that: heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007). To date, these changes do not appear to have had a negative impact on *T. reyesi*.

The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely be larger than those observed during the 20th century. For the next two decades a warming of about 0.2°C (0.4°F) per decade is projected (IPCC 2007) Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007). Various emissions scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007). Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007). The IPCC says it is very likely hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007). There is also high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to climate change (IPCC 2007). Milly et al. (2005) project a 10–30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

Although climate change was not identified as a threat to *T. reyesi* in the original listing document or in the recovery plan, the species' dependence on stable temperatures and humidity levels opens the possibility of climatic change impacting this species. Therefore, while it appears reasonable to assume that *T. reyesi* may be affected, we lack sufficient certainty to know how climate change will affect this species.

2.3 Synthesis

According to recovery criterion (1) in the Travis and Williamson RP, three KFAs within each KFR should be protected. Protection is defined as an area sufficiently large to maintain the integrity of the karst ecosystem on which the species depends. These areas must also provide protection from threats such as RIFA, habitat destruction, and contaminants. Recovery criterion (2) requires at least five consecutive years of a cave meeting KFA status and that perpetual protection of these areas is in place. Since these species were listed in 1988, there have been significant steps toward protecting caves in which they occur and meeting the downlisting criteria.

Although *T. reyesi* is known from 168 caves occurring within 7 KFRs, at this time only 1 karst preserve, located in the North Williamson County KFR, meets the definition of a protected KFA - the Priscilla's Well KFA. Other than this 1 KFA, there are 20 other tracts distributed in the North Williamson, Georgetown, McNeil/Round Rock, Jollyville Plateau, and South Travis KFRs, that may meet the definition of a KFA. However, more research needs to be conducted to delineate surface and/or subsurface drainage basins, confirm locations and tract acreage, and confirm management activities at caves that have potential to be a KFA. Once the needed analysis is accomplished and these tracts demonstrate that they meet the full requirements of a KFA, the fulfillment of recovery criterion (1) can progress. If a cave is determined to be a KFA, then information relating to recovery criterion (2) should be gathered and/or implemented to meet downlisting status. Based on additional research and/or implementation/confirmation of certain management activities, we should be able to make this determination. Until such time, we do not recommend a change in listing status for these species.

3.0 RESULTS

3.1 Recommended Classification:

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist***:*
  ____ *Extinction*
  ____ *Recovery*
  ____ *Original data for classification in error*
__X__ **No change is needed**

3.2 New Recovery Priority Number: No change

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Within the **Jollyville Plateau KFR**, fulfillment of the following actions will meet qualifications for the creation of KFAs on City of Austin lands included in the BCP:
  - Delineate the subsurface drainage basin for Stovepipe Cave, Beard Ranch Cave, and McDonald Cave located in Cuevas (Tomen Park) tract.
  - Verify footprint and subsurface drainage of Beard Ranch Cave.

- Determine the footprint, surface and subsurface drainage basins, and establish RIFA control, management of trespass, and monitoring of *T. reyesi* for Barker Ranch Cave No. 1, located in **South Travis County KFR**, owned by the City of Austin.

- To progress toward KFA status, work with landowners or organizations to confirm locations and tract acreage, determine footprints, and/or delineate surface and subsurface drainage basins for the following privately-owned caves:
  - In **North Williamson County KFR**: Karankawa and Polaris; Shaman and Pow Wow; Red Crevice, Temples of Thor, and Thor; Jensen; Lobo's Lair; Wolf"s

Rattlesnake
  - In **Georgetown KFR**: Round Rock Breathing; Steam and Fence-line Sink
  - In **McNeil/Round Rock KFR**: Blessed Virgin; Weldon; Rockfall; Raccoon Lounge; Wyoming Springs Corridor; Chaos Cave Preserve
  - In **Jollyville Plateau KFR**: Four Points complex – MWA, Eluvial, Jollyville Plateau caves; Cuevas cave complex – Tooth, McDonald

- Confirm and/or implement RIFA control and other management activities with the cooperation of landowners at the following privately-owned caves to progress toward attaining KFA status:
  - In **North Williamson County KFR**: Karankawa and Polaris; Shaman and Pow Wow; Jensen; Lobo's Lair and Wolf"s Rattlesnake
  - In **Georgetown KFR**: Round Rock Breathing; Steam and Fence-line Sink
  - In **McNeil/Round Rock KFR**: Blessed Virgin; Weldon; Rockfall; Raccoon Lounge; Wyoming Springs Corridor

- Apply recovery criterion 2 to any caves that meet KFA status.

- Draft delisting criteria and revaluate the status of the species in accordance with those criteria.

- Considering the geographic distance between northern (North Williamson, Georgetown, McNeil/Round Rock, Cedar Park, Jollyville Plateau, Central Austin KFRs) and southern (South Travis KFR) cave where this species occurs, the fact that they are separated by a major hydrologic divide (Colorado River), and that some northern caves overlap with the range of the closely related Bee Creek Cave harvestman (*Texella reddelli*), genetic analyses to confirm the presence of *T. reyesi* are needed.

5.0 REFERENCES

ACI (ACI Consulting Inc.). 2003. TPG Four Points Land, L.P., endangered species incidental take permit (PRT-808694) (amended), 2003 annual compliance report. November 14, 2003. 1 p.

ACI (ACI Consulting Inc.). 2004. TPG Four Points Land, L.P., endangered species incidental take permit (PRT-808694) (amended), 2004 annual compliance report. September 30, 2004. 1 p.

ACI (ACI Consulting Inc.). 2005. TPG Four Points Land, L.P., endangered species incidental take permit (PRT-808694) (amended), 2005 annual compliance report. November 28, 2005. 1 p.

ACI (ACI Consulting Inc.). 2006. Red imported fire ant survey and treatment for the southern portion of the Four Points tract. Submitted to Thomas Properties Group. 5 pp

ACI (ACI Consulting Inc.). 2007. Four Points 10(a)(1)(B) permit compliance summary. August 29, 2006, updated April 2007. USFWS Austin, Texas, Permit No.808694. 11 pp.

BCCP (Balcones Canyonlands Conservation Plan). 2009a. Balcones Canyonlands Conservation Plan 2007 annual report (October 2006-September 2007). USFWS Regional section 10(a)(1)(B) Permit No. PRT-788841, Travis County and City of Austin. Karst report tab. 110 pp.

BCCP (Balcones Canyonlands Conservation Plan). 2009b. Draft Balcones Canyonlands Cave Assessment. 2 pp.

Elliott, W.R. 1997. The caves of the Balcones Canyonlands Conservation Plan, Travis County, Texas. June 1997. Report to Travis County. 156 pp.

Milly, P.C.D., K.A. Dunne, and A.V. Vecchia. 2005. Global pattern of trends in streamflow and water availability in a changing climate. Nature 438:347-350.

Simon Lakeline Mall Partnership (Simon). 1992. Lakeline Mall Habitat Conservation Plan. USFWS Permit PRT-762988. 34 pp.

SWCA. 2008. A review of the karst fauna area concept and a description of the first karst fauna area established under the Williamson County Regional Habitat Conservation Plan, Williamson County, Texas. 8 December 2008. 44 pp.

Texas Department of Transportation (TxDOT). 2003. Karst conservation summary report for State Highway 45 from Anderson Mill Road to Farm to Market road 685, Travis and Williamson counties. Unpublished report. 16 pp.

U.S. Fish and Wildlife Service (Service). 1994. Recovery plan for endangered karst invertebrates in Travis and Williamson counties, Texas. 25 August 1994. USFWS Region 2 Office, Albuquerque, NM. 154 pp.

U.S. Fish and Wildlife Service (Service). 2008. Bexar County Karst Invertebrates Draft Recovery Plan. USFWS Albuquerque, NM. 125 pp.

Verdorn, R. 1994. Endangered species assessment for Sun City, Georgetown, Texas. Prepared for the Del Webb Corporation. 127 pp.

Veni & Associates. 1992. Geologic controls on cave development and the distribution of cave fauna in the Austin, Texas, region. Revised February 1992. USFWS Austin, Texas. 77 pp.

Veni & Associates. 2003. Hydrogeologic and biological assessment of caves and karst features along proposed State Highway 45, Williamson County, Texas. Unpublished report for Hicks and Company. 98 pp.

Veni & Associates. 2006. Hydrogeologic reevaluation of the proposed endangered karst invertebrate preserves on the former Kretschmarr Ranch, Travis County, Texas. Revison of a November 27, 1999, report prepared for the U.S. Fish and Wildlife Service, Austin, Texas, 60 pp.

ZARA Environmental (ZARA). 2006. Spider Cave, Travis County, Texas. Cave plan and profile. October 6, 2006. 1 p.

ZARA Environmental (ZARA). 2008. Lakeline Mall Habitat Conservation Plan 2007 Annual Report. Prepared for the Texas Cave Management Association. 26 pp.

FISH AND WILDLIFE SERVICE
5-YEAR REVIEW for the Bone Cave Harvestman (*Texella reyesi*)

Current Classification: endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__x__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: n/a

Review Conducted By: Cyndee Watson, Austin Ecological Services Field Office, Austin, Texas

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 6/26/09

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Region 2

Signature Nancy G Gloman Date 12-4-09